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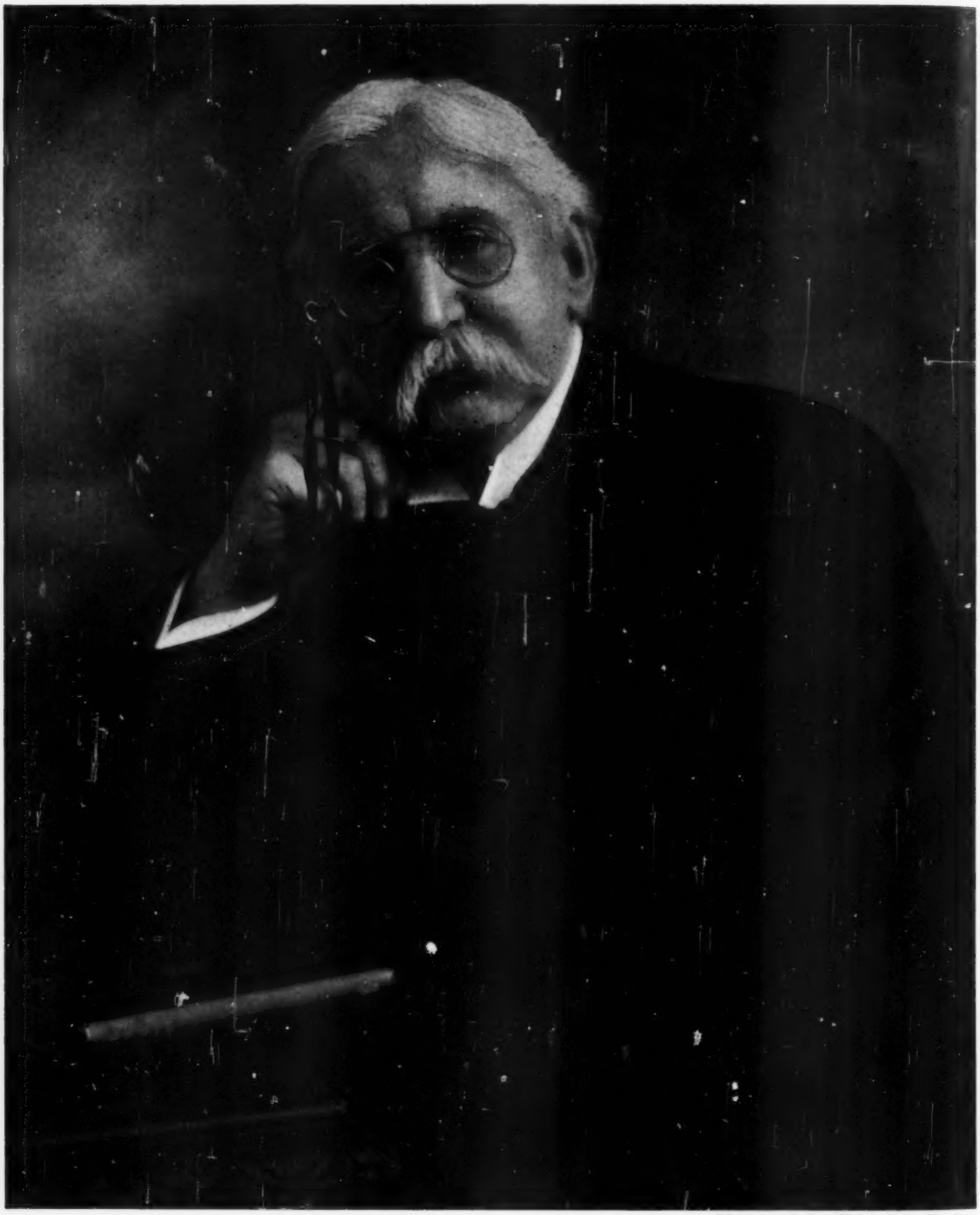

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FREDERIC AUGUSTUS LUCAS

Director of the American Museum of Natural History

Before coming to the American Museum as director, in 1911, Dr. Lucas had many years of museum service as curator-in-chief of the Museum of the Brooklyn Institute of Arts and Sciences and as curator of the Division of Comparative Anatomy of the United States National Museum. He has given his labors not alone to the technical branches of zoölogy, but he has also furthered by his writings and his museum policies the broader fields of popular scientific education

—See "The Remaking of a Museum Collection," page 222

NATURAL HISTORY

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Human Culture

ITS PROBABLE PLACE OF ORIGIN ON THE EARTH AND ITS MODE OF DISTRIBUTION

The time is ripe for organized interpretative work in world archæology, and such interpretation is of interest and importance, not only to students of anthropology, but also to the students of everything else that is human

By N. C. NELSON

With illustrations from original diagrams by the Author

THE origin of human culture is a question which has challenged the thought and imagination of man since long before the days of writing. Nearly every people, whether of high or low attainments, possess myths and legends to account for the principal inventions and technical processes of which they make use. Prehistoric man evidently recognized that such ordinary things as hammerstones and houses and domestic hearth-fires had not always been; that, in short, somebody invented them or brought them from elsewhere, and the person who accomplished such a feat for the general enhancement of human life was usually immortalized as a culture-hero. Our best known and classic example is doubtless the Greek story of Prometheus, who, with the aid of Minerva, the goddess of wisdom, went up to heaven to light his torch at the chariot of the sun and thus brought down fire as a gift to man. The implication is that Prometheus literally stole the sacred flame and for this crime he was duly punished. But the gods had been outwitted; and though they raged, they were doomed, for with the help of fire, man proceeded to make himself master of the earth.

To the iconoclastic scientist of the last few decades such explanations have too often been only mere nonsense. We are still trying to explain the many gifts which our rude predecessors have left us to enjoy; and our explanations, partial and imperfect as yet, are at best written in terse technical language which only the specialist is supposed to understand. But some day when the matter-of-fact investigator has finished the skeletal structure of his thought on the subject of human culture a gifted imagination will arise to clothe it and make it live. Of such poetic nature is undoubtedly much of the lore, like the Prometheus story, which has come down to us from the ancient East. Originally based at least in part on sound observation, it was adapted so that all who saw and heard might understand, each according to his capacity. We of the West with our cut-and-dried views on every subject have all too commonly insisted on literal interpretation where only suggestion to encourage original thought was intended.

And what now of our modern explanation of human culture? We of the present generation think that we have done much in building the aëroplane;

but in the process which we call culture history, the making of a simple pointed stick for digging edible roots out of the ground, was hardly less important. If now we should attempt to name all the discoveries and inventions which lie between these two extremes we should be astonished at how much was really accomplished before our own day.

We need not, however, go to such lengths here but we may properly ask *when* and *where* the more important inventions were made. When did man actually first make use of fire? Where were our numerous domesticated plants and animals first brought under control? What people made the first loom, the first potter's wheel, the first flint knife? The answer to these and similar questions is not yet recorded in books, nor is it handed down in reliable form as oral tradition. The material for the answer is scattered all over the world, even in places where we should not have expected men to congregate. For the most part the data lie buried in ruins located on the desert and on the plain as well as in the forest and among mountain fastnesses; they occur in mounds and in cemeteries, in caves and in rock-shelters and even in peat bogs and the muddy depths of lake bottoms. The fact of these occurrences of the record of early human life and activity has become known largely through accident and it is only of late that we have begun honestly to admit their significance and to go deliberately in search of them.

Where this search will ultimately lead we do not precisely know. But with respect to the *time* and *place* of origin of many of the fundamental elements which go to make up what we term human culture a definite opinion is slowly gaining ground. Briefly stated this opinion is, first, that the most widely distributed inventions like fire-making and flint-chipping are the oldest; and, second, that because these inventions are so nearly identical in widely separated parts of the world, they had probably a common center of origin. This center of origin is not yet definitely located but we know at any rate that it lies much nearer the center of the earth's land formation than it does to any one of the various continental extremities. In other words, it lies nearer to the meeting place of Europe, Asia, and Africa (a great traditional center of origin, it is well to recall) than it does to the Cape of Good Hope, or to the far away island of Tasmania, or to the still more distant Cape Horn.

The whole question is one of profound interest and importance, not only to students of anthropology, but also to the students of everything else that is human. The subject is here approached from the point of view of several years' archæological work done under the auspices of the American Museum in the Pueblo region of the Southwest. Certain conclusions developed from this investigation are of such a nature that they seem to throw light not only on the archæological problem presented by the whole American continent but on the problem presented by the entire world.

Discovery in the American Southwest of the Apparent Law of Distribution of Human Cultures

In 1912 the writer began archæological investigation in a hitherto unexplored section of the Pueblo area known as the Galisteo basin, directly south of and adjacent to the city of Santa Fé, New Mexico. The region, which was abandoned by native settlers finally toward the end of the eighteenth century, comprises about twelve hundred square miles and contains upward of one hundred ruins, about sixty of which are small, even insignificant, while the remaining forty attain, some of them, the size of respectable towns. After having spent a whole season sampling seven of the larger settlements, it became apparent that in addition to being

the repositories of important materials for Museum exhibition purposes, the settlements, as a group, presented a very definite chronological problem.

The ruins themselves showed some evidence of difference in age, and the broken pottery which lay strewn over their surfaces was particularly eloquent, there being a variety of styles, some of which were obviously not contemporary. In certain of the most recently vacated settlements one such style was soon eliminated as of early historic date, being always found in association with bones of the horse and other domestic animals of European origin. At the end of the second field season in 1914, through the discovery of occasional superposed ruins and also through finding a stratified refuse heap of considerable height, the time order of all the more distinctively local pottery styles—five or six in all—was determined, and it became possible at once to indicate with certainty the relative ages of the different ruins.

This principle of ceramic stratification seemed capable of extension to the remainder of the Pueblo area and, after the contemplated excavations were finished in the Galisteo region, the better part of two field seasons was devoted specifically to that type of work. Decisive results were not immediately forthcoming, partly because refuse heaps turned out to be absent in some localities; but with the assistance of Professor Kroeber and Mr. Spier, also of the American Museum staff, other methods of determining the time sequence of pottery styles were worked out, and at the present moment the general chronologic order of the most important prehistoric centers of Pueblo settlement is tolerably clear.

In connection with this stratigraphic work the writer had occasion, in 1917, to travel from Santa Fé for about 350 miles southeastwardly to the town of Pecos in Texas with a view to learning how far the Pueblo culture had formerly extended in that direction. A variety of observations was made; but we are here concerned with one only and one which was not at first recognized as of any special importance.

Santa Fé is situated on the extreme edge of the present Pueblo habitat and so, in wandering about the outskirts, one finds fragments of pottery representing all the six successive styles or types characteristic of the various ruins of the vicinity, including the modern style (No. 6, Figure on page 134) which came into general vogue about 1680. This modern ware ceases, roughly speaking, about twenty miles south of the city. About twenty or twenty-five miles farther on, beyond the southern limits of the Galisteo basin, the next preceding style (No. 5, in vogue between 1540 and 1680) disappears. Fifty miles farther out the next preceding style (No. 4) drops off. Eighty miles onward the next preceding style (No. 3) runs out, and somewhat more than one hundred miles beyond that, pottery and other indications of former Pueblo life cease altogether. Such archæological evidence as remains beyond this limit is clearly assignable to nomadic peoples.

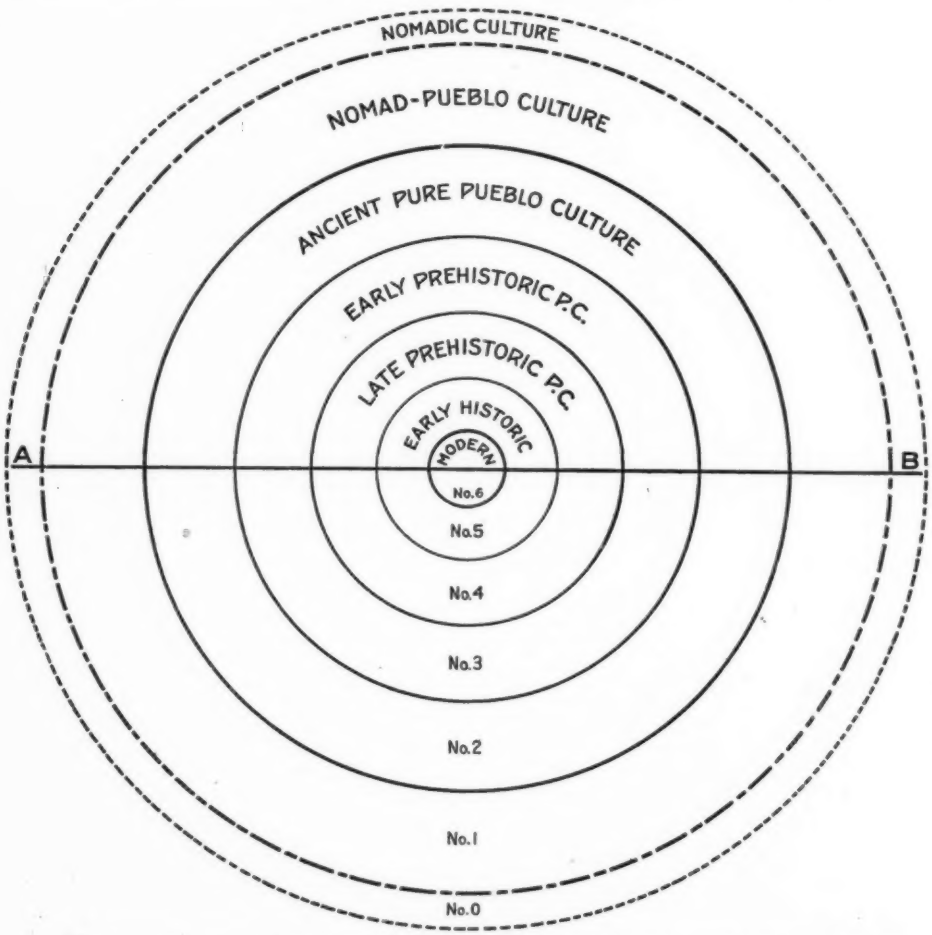
The type of pottery found in the outer Pueblo zone is not, as might have been expected, comparable with style No. 2 of the central area near Santa Fé, but is in part a mixture of the styles numbered 1 and 2. And, what is most interesting, there are associated with this pottery and certain other distinct Pueblo features several nomadic traits such as small temporary dwellings, mortars for grinding foodstuffs in place of the genuine metate, and so on. In other words, this zone clearly marks an ancient transition belt connecting the hunting tribes and the agricultural tribes.

At first this zonal arrangement caused little wonder. It was regarded simply as the accidental result of successive advances into the Pueblo territory on the part of the nomadic tribes

(Apache and Comanche) localized on the southeastern border—an invasion which was brought to a standstill close to Santa Fé in modern times. A somewhat similar dropping off of the various stratigraphically determined ceramic levels was recognized as taking place also in a northwesterly direction, the outer border being located on the shores of the Great Salt Lake in Utah. But on this line, too, there had been steady encroachment of nomadic tribes such as the Ute and Navaho.

Gradually, however, it was recognized that a very similar cultural ladder could be descended in a southwesterly direction where several tribes still live a hybrid Pueblo-Nomad kind of life. On the northeast, no very marked zoning has taken place because here a high mountain range has served to ward off invasion and the Pueblo tribes have been left nestling against its near base from the earliest times to the present.

The outstanding facts of this geographical distribution of Pueblo pottery may be represented diagrammatically as in the Figure below. And if we

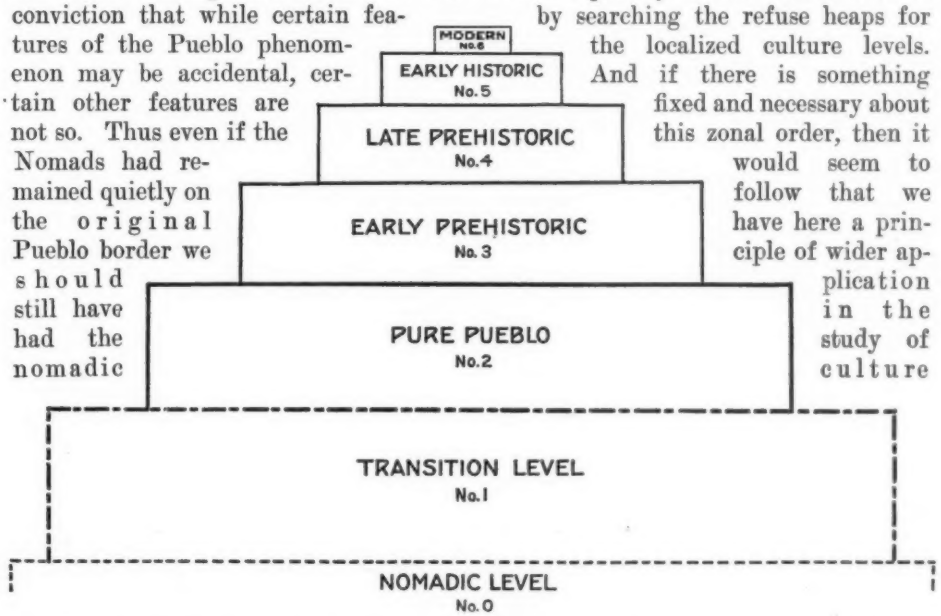


Diagrammatic presentation of the geographic distribution of six successive styles of Pueblo pottery. The distance from the center to the outer zone represents several hundred miles. Within the inner circle are to be found every one of the six styles, including the one still in process of manufacture. In the next circle every style except the modern occurs, and so on out to the next to the last zone in which only the most ancient ware is to be found. The last zone is the illimitable foreign area into which no Pueblo pottery has penetrated

make a sectional representation of the same phenomenon, to show the time order, we obtain a pyramidal structure as shown in the Figure below. Obviously the vertical and horizontal arrangements of the pottery series are identical. That is, in digging down through our refuse heaps in the surviving high center of development in order to discover the historical sequence of pottery styles, we encounter these styles in the same order in which they lie zoned out geographically. Our diagram of course does a certain amount of violence to the facts, but of that we may give account later. The aim at present is merely to clarify the general situation.

The first conclusion regarding this strange parallelism was, as has been stated, that it was a mere coincidence, an accident due to nomadic invasion. But some contemplation has led to the conviction that while certain features of the Pueblo phenomenon may be accidental, certain other features are not so. Thus even if the Nomads had remained quietly on the original Pueblo border we should still have had the nomadic region (No. 0), the transitional zone (No. 1), and the present high center of pure Pueblo development (No. 6), which in that case might today have extended over the zones numbered 2 to 5. The relative positions of phases 0, 1, and 6 would have remained the same in our two diagrams. Briefly, wherever we are able to distinguish a culture center we are bound to have, first, an inner area of pure development, second, a surrounding zone more or less affected by traits "borrowed" from neighboring centers, and third, beyond that, the distinctively foreign area which may itself break up into any number of separate culture centers.

In dealing with this Pueblo problem we might have obtained our key to the historic order of the ruins in the Galisteo basin by determining the zonal order of pottery distribution instead of by searching the refuse heaps for the localized culture levels. And if there is something fixed and necessary about this zonal order, then it would seem to follow that we have here a principle of wider application in the study of culture



Sectional view (along the A-B line) of the preceding diagram to show the relation between the geographic distribution and the historic order of development of the six recognized styles of Pueblo pottery. By digging down through the stratified débris levels, within the limits of the modern Pueblo habitat, the various successive pottery styles were encountered in the same order in which they were found in traveling radially from this place out to the extreme limit of former Pueblo influence. Roughly speaking, the older the pottery the deeper it is buried and the farther it has spread. This diagram and the preceding illustrate cultural distribution within a single limited area; but the order observed appears to hold true in a measure for all culture areas and for culture as a whole in its distribution throughout the world. This wider application is illustrated by the diagrams on pages 138 and 139

history. By means of this principle we may be able without turning a spadeful of earth to throw considerable light on a number of historical problems, great and small, which have not yet been illuminated by the application of thorough-going archæological methods. Space limitations forbid elaboration in this place but one or two applications may be at least suggestive.

Application of Apparent Law of Distribution to the American Continent

First, let us shift our point of observation from the Southwest to Middle America, that is, southern Mexico, Central America, and northern South America. Here we find ourselves, as it were, on the summit of aboriginal New World achievement. From this summit, if we look northward over what is today tolerably well known terrain, we see a series of more or less distinctly marked culture zones occupying successively lower and lower levels; and if we then look southward we perceive a nearly corresponding series of zones in that direction.

Thus matching the Pueblo culture on the north we have the so-called Calchaqui culture on the south, in northwestern Argentina. On comparing these two widely separated centers we find not only a general similarity in fundamentals but actual identity in the case of several specific traits. Beyond this zone we observe a transition belt inhabited by tribes who have adopted the rudiments of agriculture but who still retain many features of the hunting type of life. This belt in the north would include all of the eastern two thirds of the United States. Still farther out comes a broad belt inhabited by non-agricultural tribes, that is, nomads who have developed a comparatively high type of hunting culture and who, whether roaming or stationary, are in possession of the northwestern United States together with most of Canada to the north and most of the vast interior portion to the south, in particular the Pampean regions of Argentina. Finally, on the extreme margin of the continent, along the Arctic shore on the north and in Tierra del Fuego on the south, we have remnants of two somewhat unevenly specialized centers which, however, from the point of view of Middle America, we may properly group together and classify as a low type of hunting culture.

Complete justification of all the preceding assertions would require lengthy discussion. Still, the only point here insisted upon is the general pyramidal character of our continental phenomenon, and that no one can deny. In the former case of the Southwest, we were obliged to admit the Pueblo pyramid to have been produced perhaps in part by the accident of nomadic encroachment. In the present case of America as a whole, our pyramid is the result of exactly the opposite tendency: archæological investigations clearly show the higher continental cultures to have been steadily encroaching on the lower. Nevertheless, in both cases the pyramidal condition remains and for that reason the writer is convinced that it is not an accident but is instead an almost axiomatic fact.

In attempting now to offer an explanation of the visibly corresponding culture zones of North and South America, we are not required to deny the influence either of environment and psychic unity on the one hand or of recent trait transmission by borrowing on the other. We may insist, however, that none of these explanations is entirely adequate; and that instead—on the basis of analogy with our demonstrated Pueblo phenomenon — these zones correspond for the much simpler reason of being actually surviving parts of one and the same culture center which formerly extended over all the intervening area. Each pair of segments in turn, beginning with the Eskimo-

Fuegian, has been separated and the connection obscured by the superimposed development of a higher culture.

The archæological test of this hypothesis is easily applied. All that is necessary is a careful determination of the various culture strata to be found beneath the topmost layer of our great pyramid. If the zonal arrangement pointed out for the continent at large has any real historical significance, then we should find in Middle America a corresponding stratigraphic arrangement. And, already, sufficient has been accomplished in this direction to assure us that the final result will come out virtually as indicated.

This should mean, briefly, that the earliest culture wave to sweep into the New World was of the hunting type and approximately on a level with that of the Fuegian tribes of today. In the course of time this culture came to characterize the entire continent, but was displaced by higher developments in the narrow confines of Middle America at a comparatively early date, possibly long before the original primitive phase had reached its present marginal positions in Tierra del Fuego and Greenland. On some such basis it seems possible also to reconcile a good deal of conflicting anthropological opinion regarding early man in the New World. For while all agree as to the generally primitive character of Eskimo-Fuegian culture, some maintain that it is not at all ancient. If now we can show this type of culture to lie at the bottom of Middle American developments we shall probably at the same time establish for it a very respectable geologic antiquity.

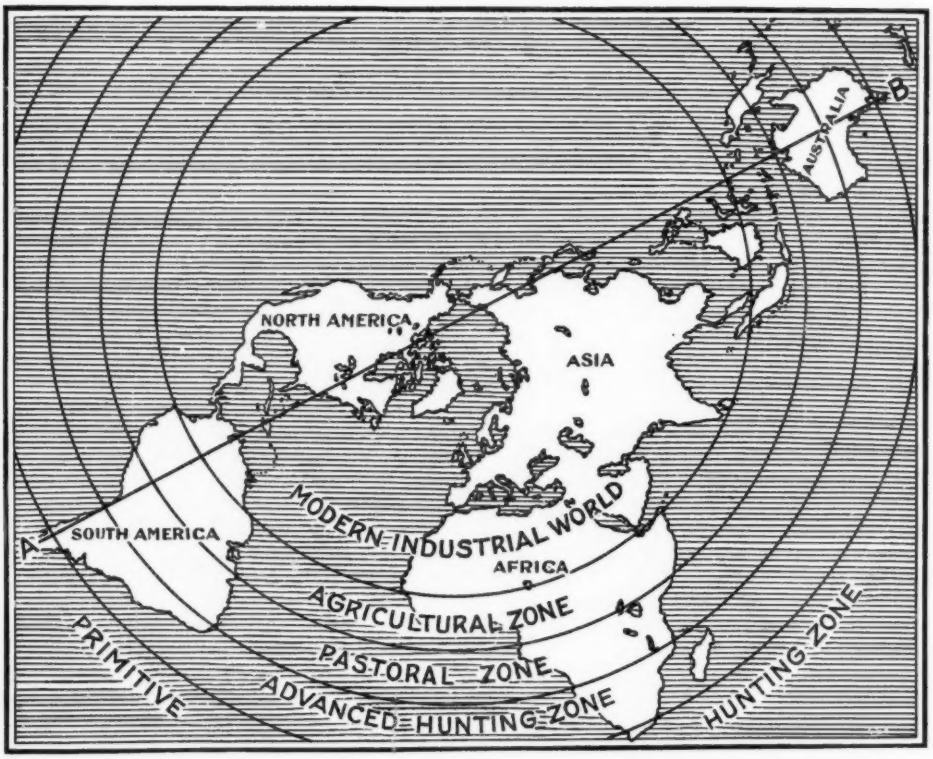
Application to the World as a Whole

The pyramidal idea, proved for the Southwest and indicated as probable for the American continent, seems true also in a general way for the world at large. Unfortunately, the earth's land formations and their climatic provinces are not so disposed that we can give an adequate demonstration of the geographical aspect of culture distribution by simply laying down a series of concentric circles. Still, the idea to be conveyed may perhaps be made more directly intelligible by such procedure, even at the risk of doing absolute violence to some of the facts we are considering. The best that can be done is to present a map of the inhabited world on a Bering Strait projection and with that point as a center describe our circles in a partly arbitrary fashion. (See illustration, page 138.)

The zones thus indicated might be variously named. Perhaps our ethnological terminology will serve best and we may begin on the extreme border and repeat inward toward the Bering Strait center, in succession: lower hunters, higher hunters, pastoral nomads, sedentary agriculturists, and industrialists. It is not, of course, contended that this simple distribution scheme is literally true in all of its details, but merely that it is more true than false or, in other words, that it is fundamentally true. The most primitive cultures do fall within the outer zone, as the most complex fall within the inner circle, and whether we approach this inner circle from Tasmania or South Africa or Tierra del Fuego, we do encounter the advanced cultures in approximately the order indicated.[1]

We have, lastly, to look at this horizontal phenomenon in its vertical aspect. Each of our most primitive cultures, surviving here and there on the margins of the Old as well as of the New World, shows such striking similarity to one phase or another of the ancient Palæolithic culture of western Europe that few students have failed to note the fact. And the notion of possi-

[1] It will perhaps be pointed out that a corresponding series of zones should be plotted within our inner circle of high development, grading down in reverse order toward the Arctic Ocean. But the circumpolar phenomenon has been left out purposely in the present broad treatment, first for the sake of clearness, and second, because it is, after all, a feature due largely to environmental conditions.



Diagrammatic presentation of the general geographic distribution throughout the world of the commonly recognized culture stages at the time of the discovery of America. The indicated position of the given zones on any one of the three continental land masses crossed by them is not to be taken literally throughout, nor is even the order of names to be considered hard and fast. In South America, for example, the "pastoral zone" is all but nonexistent. Accurately drawn, the zones should not be indicated by true circles but by something like isothermal lines which would actually eliminate most of North America and a good part of northern Asia from the central area as now constituted. The idea to be conveyed by the above rigid diagram is simply this, that the world's most advanced cultures are at home within the central area and that, as we travel out from this center toward any one of the three land mass extremities, we find ourselves descending a cultural pyramid; and, finally, that the farther out we go the cruder and more nearly alike the cultures for the distantly separated land masses become. In other words, the cultural attainments of the native tribes of Tasmania, South Africa, and Tierra del Fuego, although very far apart in space, are almost the same; whereas by contrast the cultures characterizing the central area are highly differentiated.

ble historic connection thus engendered is greatly strengthened by a consideration of the archæological data for the world at large.

In the case of America, for example, we discover at once that the resemblance in question was formerly closer than it is today. Briefly stated, our Eskimo and Fuegian cultures, especially the former, show strong Magdalenian[1] affinities. For the continent at large, however, the Solutrean flint technique is typical and has been typical, it seems, throughout nearly the whole known history of American developments. Only here and there, for instance along the Argentine coast, on the isle of Cuba, and in the Ozark and Mammoth Cave regions, have we obtained more or less distinct traces of chipped stone artifacts which in type and technique resemble the Aurignacian and Mousterian products. Whether we shall ever be able to isolate definitely something corresponding to the Acheulian and Chellean phases remains to be seen; but when we stop to consider the relatively enormous time interval covered by the

[1] Various European culture levels of Palæolithic time, determined by the character of the stone and other implements used by early man, and thought to range backward from a few thousand to 400,000 and more years, are in their order counting backward from modern and Neolithic as follows: Magdalenian, Solutrean, Aurignacian, Mousterian, Acheulian, Chellean, Strepyan, etc.

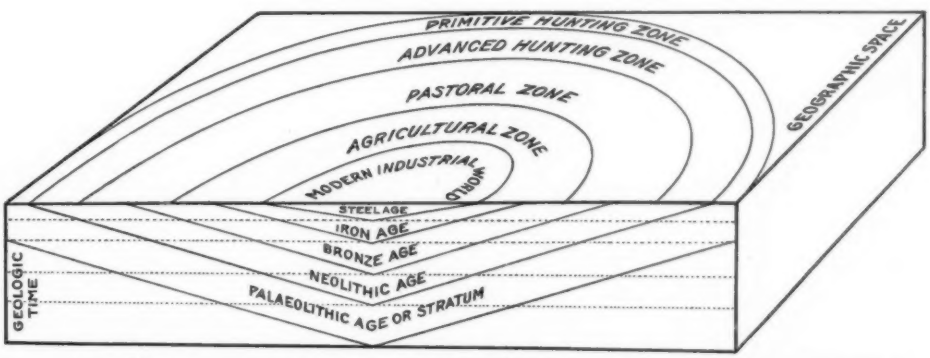
coup-de-poing type[1] of implement and when we bear in mind also its nearly complete distribution over the Old World, it becomes obviously hazardous to exclude its occurrence from the New World.

Most likely we shall some day reverse the balance of American opinion against the genuine antiquity of the scattered finds already made in the drift of the Delaware and Ohio basins. But even if this should come to pass, it is probable that the various phases of Palæolithic culture as we know them at their best in western Europe can never be brought out into sharp relief in America. That is to say, we shall never be able to obtain clear and detailed stratifications, because the best part of the New World was so far away from the center of origin that the earliest culture waves had spent themselves before they arrived here.

No attempt can here be made to fix this center of origin or even to suggest that it ever can be identified with any particular locality. All that can be stated at present is that seemingly the oldest archæological data known have hitherto been found within the limits of our inner circle, which also marks our present center of high development. Our oldest cultural remains have thus far been found in the vicinity of the Mediterranean, but for various reasons, theoretic and practical, it seems probable that still older remains might be found farther to the east, roughly speaking in central or southern Asia. But, wherever the first real inventions were made, it would be preposterous to suppose that all other inventions, even the most primitive and fundamental, were made in that same place.

Throughout nearly all of culture history, conditions were probably much as they are today: there were a number of culminating centers and the dominant one may at times have been difficult to recognize; but at any rate no particular center retained permanent sway. As within historic times, every particular culture phenomenon probably refined itself to the point of stagnation and ultimately fell an easy prey to any vigorous barbarian group. In principle there is no difference be-

[1] The *coup-de-poing* type of implement resembles a large crudely made spear point and is the oldest implement recognized as intentionally made by early man.



A possible explanation of how the zonal similarities for the separate continents came about is illustrated by a sectional view along the generalized A-B diameter of the preceding diagram. The view is taken along this A-B diameter but it should actually follow a line running through western and southern Europe as well as southern and eastern Asia. The diagram is largely self-explanatory and is a repetition of the first two illustrations, with simply a change of text. The only real modification occurs in the sectional portion where the pyramid has been inverted in order to indicate the passage of time while the normally associated groups of inventions and practices traveled from the center of origin out toward the margin of the inhabited world. Only the relatively crude cultures have arrived on this outer margin, where it is said they are not very ancient; but in the center of high development these same crude cultures lie stratigraphically very deep or, in other words, are decidedly ancient. For that reason it is assumed as likely that most of the world's great culture stages first arose in the central area and spread from there as successive waves in all directions

tween the decline of the Pueblo culture and the fall of Rome.

With all these limitations and precautions in mind we may conclude our semi-speculative survey of human culture with a diagrammatic presentation of what seems to be the essential historic and geographic factors involved. The elements of this diagram have already been set forth in connection with the Pueblo phenomenon. The zonal schematization we may leave unmodified, but the sectional presentation, reared in the form of a steplike pyramid, although apparently correct, is actually faulty, as was stated. The constructional error in question was not so obvious, however, in the case of the minor Pueblo pyramid as it will be in the case of our great world pyramid. Briefly stated, the difficulty hinges on the fact that no single invention and much less any whole cultural complex, wherever it originated, could spread all over the inhabited world in the twinkling of an eye. If we grant, for the sake of argument, that density of population and consequent specialization along various lines of activity first came to a head somewhere near the meeting place of Europe, Asia, and Africa, it is obvious that it would take a considerable period of time for even the most adaptable sort of invention to reach, let us say, Tasmania and Tierra del Fuego.

As is plainly evident, very few of the advanced ideas concretely realized in the central area of high development ever reached the outermost zones; and, regarding those which did arrive there, we are constantly being told that they occur only superficially, whereas, in the inner area, the corresponding primitive forms lie stratigraphically deep. This signifies undoubtedly that millenniums of time passed while the various successive adaptations in culture spread over the world. To represent the fact diagrammatically we have simply to break the horizontal division lines of our terraced pyramid in the middle and then raise up both of the outer ends. This in effect inverts our old pyramid and enables us at the same time to combine the time and space diagrams into one. The result is indicated in the Figure on page 139.

This paper is an attempt to present the large and complex subject of human culture in its simplest possible terms. The explanation is not finished. Actual inspection of details would immediately bring out numerous difficulties and weaknesses. It is not, of course, argued, for instance, that the surviving cultures as we view them today, from the central to the extreme zone, will give us an exact picture of human cultural development. All the while since differentiation set in, these zones have reacted on one another. That is, a few traits have flowed perhaps both in and out on horizontal lines in addition to the many traits which welled up as it were from below. But in a general and at the same time in the most profound way, the outer zone has unquestionably preserved for us the really ancient culture.

We may properly conclude with something in the nature of a prophecy. The signs of the times are auspicious. Events of the last few years have brought it about that men, in planning the future, have to think in world terms or fail. There is a sense in which the same is true also in connection with reconstruction of the world's past. If, after a century of exploratory work in archæology, we still continue over local minutiæ to the exclusion of everything else, we shall ultimately become so burdened with endlessly duplicated detail facts that no man can master them and the wasteful procedure will break down of its own weight. If, on the other hand, we simply dare to see our problem whole, then surely many of our present minor difficulties will fade away of themselves. The time is ripe for organized interpretative work.

Nature Reflected in the Art of the Ancient Chiriquians

By GEORGE GRANT MacCURDY

Assistant Professor of Prehistoric Archæology and Curator of the Anthropological Collection, Yale University

THE age of the cave artist was the age preëminent of fundamentals in art. It was then that the arts of sculpture in the round and in relief, of engraving, and painting were born and first flourished. This troglodyte art was remarkable for its realism, especially throughout its earlier phases. It dealt with life forms, for the most part those of animals useful to man. Its beginnings and its realistic character were due in a measure at least to the necessity of controlling the food supply.

With the final retreat of the continental glaciers and the disappearance of the reindeer and the mammoth from western Europe, cave art suffered an eclipse. The Palæolithic period was followed by a more practical if less artistic age, the Neolithic. While the men of the New Stone age contributed in their turn to art progress, it was in other directions, notably through the far-reaching discovery of the ceramic art.

In any discussion therefore of Neolithic art, ceramic art plays an important rôle. This is true not only of prehistoric Europe but also of prehistoric America. Since many of the ornamental designs that have had such a vogue in historic time had already taken shape before the dawn of history, their origin is to be sought for in prehistoric records. Since the problem in Europe is more complex than that in America, I have chosen some prehistoric American examples, which seem to illustrate the principles that control the origin and evolution of ornament in art. These prove that Neolithic art, like cave art, reflected almost exclusively man's zoölogic environment; they also indicate that man's attitude toward this environment had changed somewhat, the change being measured by the extent to which realism was replaced by conventionalism, and the ex-voto by the totem.

During the earlier as well as the later Stone age, man must have taken a certain delight in the beauty of animal forms independent of their real or supposed influence upon his fortunes; his ability to reproduce the chief features of the animal forms which interested him most no doubt gave him added satisfaction.

The examples chosen all come from a single restricted culture area, namely the province of Chiriqui on the Pacific coast of Panama, and have been selected principally from the unrivaled collection of Chiriquian antiquities in Peabody Museum of Yale University. The specimens belong to the late Stone age, or, to be more exact, the transition from the Neolithic to the age of metals. They are almost wholly from the field of ceramic art and date from a time when the use of the potter's wheel was still unknown in America.

The pottery of ancient Chiriqui is divisible into a number of rather distinct groups depending on the nature of the paste and slip, the form and finish, the presence or absence of paint, and above all the character of the ornament; whether in the round, in relief, incised, or in color; and if in color, the method of producing the design.

An outstanding feature of ancient Chiriquian pottery is the association of a given animal with a given kind of ceramic product. The next and chief

phenomenon is the proliferation of a whole series of decorative motives grouped about a single animal form and presumably derived from it. If this be true, then Chiriqui affords some striking proofs of the way ornamental designs have arisen and of the preponderating influence of conventionalism in their evolution.

A knowledge of the folklore of the ancient Chiriquians might throw light on why the artist made so much of certain animals while ignoring others. This choice might well have been influenced by various considerations such as totemism, tradition, comeliness, or even the mere coincidence of similarity between some artificial product and some well-known animal form. The favorite models were the animals common to the region in question, those whose peculiarities of form and of habit were not beyond the reach of common knowledge. While the artist often produced figures with mixed attributes, their component parts are always referable to living local forms rather than to fabulous creatures.

The largest group of ware is characterized by a distinct kind of paste and slip, the absence of paint, a remarkable purity of form and finish, and ornamentation in the round or in relief. The ornamentation dominant is taken from the armadillo. A favorite adaptation is the use of a more or less realistic figure of the armadillo as tripod supports; another is the perching of the figure on the shoulders of vases. More remarkable still is the isolation of a single feature or part of the armadillo and its use as a decorative motive independent of and at the same time representative of the whole: the eye, the foot, the tail, a band of the carapace. A pleasing pattern for the neck of a vase is a series of carapace motives or tail motives, in zigzag, with a foot or an eye symbol filling each angular space. Each carapace band, or each tail, as the case may be, is executed skillfully as well as realistically. Only when it comes to the arrangement, the disposition of the series, is there a departure from nature.

In dealing with the armadillo figure as a whole the artist allowed himself considerable latitude. At times he was satisfied with nothing less than a faithful copy. At other times reduction and simplification of parts were carried so far as to render identification difficult. Again, the artist indulged in the reduplication, exaggeration, elimination, or fusion of parts, at all times, however, leaving an unmistakable though indefinable stamp upon his work, a touch that entitled him to rank as a student of nature and, by virtue of this, as a true artist; for the two go hand in hand, are inseparable.

The reasons why the Chiriquian artist gave special prominence to the armadillo are somewhat obscure, beyond its local occurrence, peculiar habits, and its utility as an article of food. Its mythological background is trifling in comparison with that of some other animals; but this could be accounted for in part at least by its limited range. On the other hand the bird and the serpent have a very wide geographic distribution; and curiously enough these are, above all others, the mythological world favorites. It is therefore not at all surprising to find the trail of the serpent in ancient Chiriquian symbolism. In fact it is the chief decorative feature in one small group of ware and has left an impress on two other groups. Like the armadillo ware, the serpent ware belongs in a class by itself because of its distinctive (black) paste and slip and the fact that the designs are incised instead of being in the round or in relief. Moreover, the effect of the incised pattern is heightened through the filling in of the incisions with a white substance.

The favorite theme is a long serpentine body with a head and protruding forked tongue at each end. The whole

forms a balanced and somewhat stylistic figure, which is repeated on the opposite side of the vase. With the elimination of the heads, the breaking up of the body into geometric patterns, and the shifting of the body markings from their original position, the symbolism sometimes reaches a stage of almost complete disguise. As long, however, as the artist confined himself to the distinctive serpent ware his meaning is comparatively clear. When, and if, he attempted to carry this conventionalized serpent symbolism over into other groups of ware calling for a change of medium and technique, and where other motives dominated, the results became confused with designs that started from wholly different originals.

Like the bird and the snake, the fish has an all but universal range, but it does not seem to have left such an indelible impress on the mind of primitive man as have the former two. Chiriquian waters abound in fish, which must have been one of the chief sources of food supply among the ancient inhabitants. Nothing could be more natural than that the potter should endeavor to reproduce a form of such utilitarian as well as artistic adaptability. In fashioning the long tripod supports for urn-shaped vases he would inadvertently arrive at a form suggesting the outlines of a fish; the fortuitous resemblance could be heightened *ad libitum* by emphasis upon such details as the nose, eyes, and fins. In some examples the piscatorial attributes are suggested by the merest touch, such as the slight flattening at the end to indicate the tail fin or the application of a single node on the back to represent the dorsal fin. In others the details are worked out with such care that one is able to identify the exact species.

Few animals have left a more potent symbolic impress upon the culture of various peoples of the earth than has the alligator or crocodile (Spanish *el lagarto*). The extent of this influence is revealed in art. The prototype of the Chinese dragon is no doubt the alligator, with which the Yangtze River teemed in prehistoric time and which must have filled with terror the heart of the riparian rice-grower of that period (as pointed out by Dr. Berthold Laufer). It was probably the Egyptian crocodile that inspired the author of the book of Job to write: "Canst thou draw out leviathan with a hook?" As was the case in China and Egypt, so it was in Chiriqui, where the record is none the less complete because of its being pictorial instead of written.

Representations of the alligator not only are confined almost wholly to two related groups of Chiriquian pottery but also are dominant in these groups. Since both groups depend on color for their ornamentation, the alligator occurs consistently in painted forms only, never as a figure in the round, in relief, or incised.

The larger of the two groups is known as alligator ware and is characterized by a paste of excellent quality, a cream-colored slip, and by red and black delineating colors, both being of an enduring nature. The more realistic figures of the alligator are in profile and decorate the bodies of globular vases, one being painted on each side. The artist emphasized certain features of the animal by preference: jaws of exaggerated length and recurved, especially the upper one, undue prominence of the frontal region, a synclinal sweep of the body line, and a scrupulous care that the scales and spines be not omitted. A favorite method of bringing the scales into view was to group them in triangular or semicircular fields that rose above the dorsal line. Profile figures of the alligator are encountered ranging all the way from elaborate realistic representations to a simple abbreviated horizontal body curve with a single dot in the hollow of the curve to indicate the dorsal body markings.

SERPENT WARE

Representations of the serpent on Chiriquian pottery are almost wholly confined to one small ceramic group, the so-called *black incised* ware. On this the serpent motive is so all-pervading as to justify the name *serpent ware*. The deep incisions in this ware were made before the paste hardened and were filled with a white substance that stands out in bold contrast with the black ground. The geometric decorations of the uppermost vessel here shown are a survival of the serpent symbol. In the second figure the body of the serpent with head at both ends passes around the body of the vase three times.

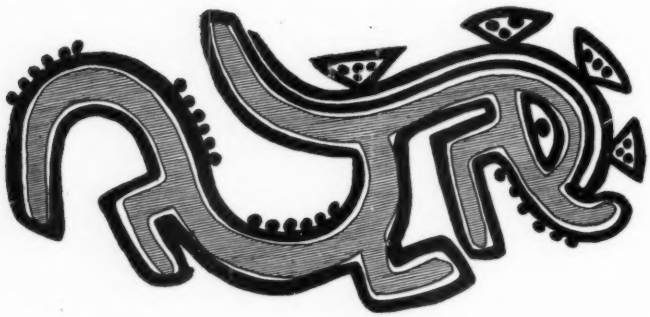
Opposite sides of the third vase are decorated with a pattern evidently intended to represent a similar serpent with head and forked tongue at each end. The body of the serpent is folded on itself in such a manner as to produce geometric outlines and thoroughly cover the field to be decorated. The handles of this vessel, where they merge into the lip, are crossed by an incised fillet resembling the carapace symbol so common in the armadillo ware. A breaking up of the elements that enter into the realistic representation of the serpent is sometimes seen, a series of triangles being formed by the body motive with the markings appearing only in the enclosed spaces. This results not only in economy of labor but also in more thoroughly covering the area to be decorated; hence conventionalism has ever been as much the child of economy as of ritual

ALLIGATOR WARE

The skill of the ancient Chiriquian artist is nowhere better displayed than in his treatment of the alligator, representations of which characterize two related ceramic groups (the so-called alligator ware and the polychrome ware) which, unlike the armadillo ware, depend on color for ornamentation. In this profile figure are combined the chief features of the alligator, including scales and spines

It is by no means certain that the ancient Chiriquians may not have had in mind the crocodile rather than the alligator, since both are found in Chiriquian waters. The length of jaw depicted at times by the artist seems to indicate the former instead of the shorter muzzled alligator. The stylistic figure here shown has a head at both ends of the body. Dots representing eyes and teeth are placed where space invites rather than where they belong

What at first glance looks like a meaningless bundle of waving arms portrayed on this vase is a conventional treatment of the alligator with the head turning backward. The much exaggerated jaws extend over the back and tail, balanced by a long appendage on the neck, while the space below is amply filled by a relatively small trunk, tail, and legs



A favorite representation shows the alligator in absolute profile. Note the open mouth with teeth, the upturned snout, the dorsal markings on the head and tail, and the long crest attached to the neck

Vessels of the alligator group mounted as tripods are comparatively rare. The supports are usually short, solid, pointed cones marked by horizontal black bands. In this vase from El Banco the neck is quite short and the shoulder decoration consists of three panels each bearing a series of scale-group symbols.

The profile view of the alligator is here reduced to its simplest elements: the curve of the body line and a dot in the hollow of the curve to represent the scales on the back of the animal

A representation of the alligator similar to the figure at the top of the page is here shown, the body markings being represented by only one type of scale-group motive, repeated three times on the head and five times on the tail

Not content with his success in executing the profile view of the alligator, the artist also took special pains to picture the dorsal aspect of the animal, a difficult problem happily solved through the aid of conventionalism. By means of a series of parallel lines the rows of spines on the alligator's back were indicated; while to the lateral margins of the series were attached spines or dotted triangles to represent the scales. To these triangles I have given the name scale-group motive, while the figure as a whole I have called the dorsal-view motive. The latter is a favorite decoration for arched panels on the shoulders of vases.

The other group of ware in which alligator motives prevail is small but of special importance. It is known as polychrome ware, and is at once recognizable through the addition of purple as a delineating color, special skill in the elaboration of designs, and versatility in the shaping process. It is in this group alone that we find the highly ornamental branching scroll pattern evolved from the multiple body line of the alligator combined with a series of alligator profile motives.

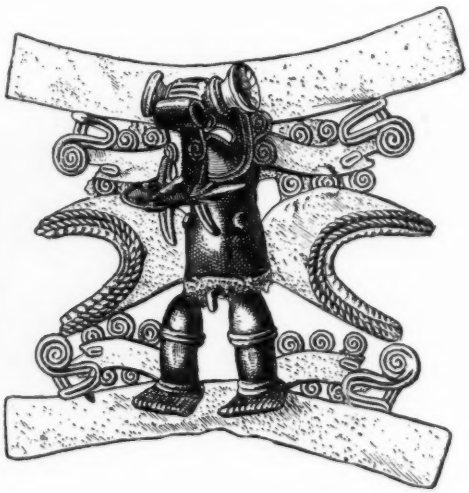
In this rare ceramic group we find a painted figure with alligator and human attributes combined—alligator head on a human body to which are attached human arms and legs and an alligator tail—a figure which I have called the alligator god. The alligator god was a particular favorite with the Chiriquian metal worker. Over and over again we find him among the gold figurines. His human feet are usually planted on the body of an alligator, to each end of which is attached an alligator head and undifferentiated forelegs; while on his alligator head rests a similar double-headed alligator inverted.

The octopus frequents the waters on both sides of the Isthmus. Like the alligator it might be expected to cast a powerful spell over the mind of primitive man. The reasons for this would be clear enough if one could see it through the eyes of the *Travailleurs de la Mer,* as Victor Hugo attempted to do. The prehistoric as well as the historic art of the Mediterranean region bears abundant evidence of this. Figures of the octopus, both realistic and conventionalized, occur in the art of ancient Greece and elsewhere. Passing to the New World, one readily encounters two centers of the octopus cult, Peru and Chiriqui.

In Chiriqui we find the association of the octopus with a single kind of ceramic product, which for the sake of convenience we may call octopus ware. This ware differs from the alligator group and both differ from the armadillo ware. In point of numbers the octopus group ranks next to the armadillo group. It consists for the most part of slender-necked globular vases of medium size. The prevailing color of the slip is red. On this the designs were laid down in wax. The part to be decorated was then treated with a uniform coat of black. Later the vessel was passed through a hot bath; this melted the wax which carried with it portions of the overlying black, leaving the desired pattern in the color of the ground. The technique and the nature of the colors employed are thus wholly different from those in the ceramic groups already described. The only point in common is that here again the prevailing decorative motives center about a single zoömorphic original—the octopus—and are presumably derived from it.

There is something peculiarly fitting in the association of the octopus with small-necked round-bodied vases that depend for their ornamentation upon a system of negative painting. By adding eight appendages the body and mouth of the vase at once become the body and mouth of an octopus. This is equally the case whether the arms depend from the neck or rise from the

Polychrome ware is remarkable for its rarity as well as for its refinement and beauty of ornamentation. It is more closely akin to the alligator ware than to any other, the delineating colors, black and red, being the same, while the addition of purple in many cases gives a distinguishing character. The elaborate branching scroll decorating this vase is derived from the multiple body curve of the alligator, to which seven alligator profile motives are attached (compare with third figure, page 146)



The alligator god (at the left).—This extraordinary design on the inside of a cup or chalice of polychrome ware represents the human body and extremities surmounted by the alligator's head with all its characteristic traits. The artistic red and purple spines are attached to the crests instead of to the head proper. It has been observed that there is great resemblance in this decoration to that of the earliest known period of Chinese art

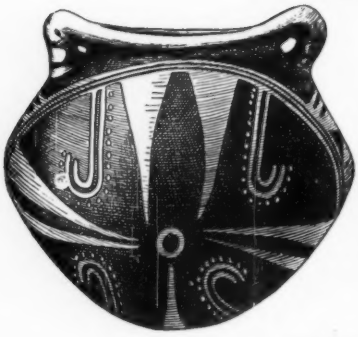
The parrot god (at the right).—The human body is sometimes combined with avian attributes, as seen in this figure cast in gold. Even here alligator symbolism is present in the foot rest, which is repeated in inverted position to form the headdress of the god

Octopus ware, showing realistic figure of an octopus.—One of the best examples of the association of a given animal with a certain ceramic product is exemplified in this so-called octopus ware, which like the alligator ware depends on color for its ornamentation. The method of producing the design and the nature of the colors used are, however, very different in the two.

In this example of octopus ware the octopus appendage alone is used. It appears in a curved frondlike representation and also in the guise of a short-based triangle with a series of dots representing the suckers, these motives alternating in a series below the neck of the vessel

FURTHER EXAMPLES OF OCTOPUS WARE

Outlined in black on a light ground, eight octopus arms (of the curved frond type) depend from the neck of this vase, the neck and mouth of the vase being in the position of body and mouth of the octopus.



Triangular and curved frond octopus appendages converging toward the center of a circular panel. On the vessel at the right there are four sets of appendages, namely, one descending from the neck, one rising from the base, and two converging toward the centers of opposite circular panels

Here the triangular and frond type (the fronds are straightened) of octopus appendage alternate, filling an arched panel. The straightened fronds bear two rows of suckers each

A pale yellow and black vase has a zonal decoration. The two broad black bands are broken up by a succession of diamond-shaped figures each representing an octopus body. (Compare with figure at top of page 149.) Appendages have been eliminated and dots indicating the suckers have been placed within the body areas

vessel's maximum horizontal circumference.

Again the globular shape of the body makes it possible to describe a circular panel on each side. This is sometimes filled by a realistic figure of the octopus. Again in the center of this panel a small circle may be traced; and toward this make-believe mouth as a center, octopus appendages converge from the periphery of the panel. Thus can a single vase be made to represent two complete octopus figures. In some examples the reduplication is repeated about the neck and bottom of the vase respectively, resulting in a quadruple representation of the complete octopus figure.

The one outstanding feature of the octopus is the set of eight suckered appendages; to these the Chiriquian artist gave special attention. The more realistic appendage representations are frondlike and accompanied by a row of sucker dots along the convex margin. The less realistic appendage motive takes the form of a short-based triangle, with a row of suckers paralleling one or both of the long sides. From both the frondlike and the triangular appendage the suckers are often omitted, or they may appear by transposition on the body of the octopus.

In addition to the armadillo, serpent, fish, alligator, and octopus,[1] each of which is dominant in a distinct ceramic group, there are several other animals which appealed more or less to the fancy of the artist. Among these are the frog occurring by preference in the armadillo group, the monkey, raccoon, squirrel, iguana, tapir, deer, peccary, crab, owl, parrot, and jaguar. The two last named are met with not only in the alligator ware especially as whistles but also among the metal figurines. Both are sometimes combined with human attributes to form what I have called the jaguar god and the parrot god.

The development of decorative and symbolic art is not to be demonstrated by means of mathematical formulas; that its manifestations are however subject to the laws of growth and of decay, there can be little doubt. In the evolution of ornament in art, the haphazard plays an insignificant rôle. The reasons for each step may not always be obvious, but they exist nevertheless. The work of a given artist reflects alike his spiritual make-up and his environment, cultural as well as natural. The marks of kinship running through the group of alligator or octopus motives, for example, rest on a more solid basis than mere fortuitous convergence toward a common type. Each artist either had in mind the common source of inspiration, or else copied from someone who was drawing on that original source. The source is always and everywhere nature; and that art is best which remains true to its source.

[1] Mr. B. W. Merwin of the University Museum, Philadelphia, has recently called attention to a snake (*Crotalus durissus*) from Chiriqui, the scale pattern of which is not unlike some of the designs to be found both in the alligator and octopus ceramic groups. In other words, with such an exuberant proliferation of decorative motives derived from a single zoömorphic original there is ever present the possibility of the overlapping of motives that started from wholly different originals. For example dots were employed not only to represent the scales of the alligator but also for the suckers of the octopus; they might also be made to stand for spots on a snake's back. The dotted triangle served as a convenient symbol for groups of alligator scales. On the other hand a short-based triangle accompanied by dots along one or both of its longer sides was without the shadow of a doubt derived from the octopus appendage. A realistic representation of the body pattern of a Chiriquian rattlesnake is satisfactorily expressed by means of rhombs, and perhaps even by triangles. The confusion arising from possible convergences of this kind is, however, reduced to a minimum by the fact that the three animals in question are each dominant in its own distinctive ceramic group. In the alligator ware, the influence of other animal forms is negligible; the same is true of the octopus and the serpent wares. The probabilities are therefore that a dotted triangle is not a serpent motive when occurring on alligator or octopus ware; neither is it a scale-group symbol or appendage-sucker motive if occurring within the ceramic group known as serpent ware. This much can be said without denying the possibility of the reverse being true in exceptional cases.

Peace Conditions

Parallelism between the development of the high animal organism and that of the super-nation, both in accordance with broad general principles of organization: especially mutual dependence and coöperation

By JAMES G. NEEDHAM

Professor of Entomology and Limnology, Cornell University

PEACE-KEEPING is not so much a matter of treaties signed at the close of hostilities, as it is a state of public mind. "Peace terms," so called, may be named arbitrarily by the authorized representatives of warring states; but peace conditions are fixed in the psychic organization of our species. The "terms" must conform to the conditions; else there will be no lasting peace.

What are the conditions? How shall concord and organic health be assured in the political organization of the world?

Much light is shed upon the problems of organization by the study of nature's supreme model, the body composed of cells. These are the units of a lower order, that correspond to the persons composing the body politic. In our own bodies they are so highly integrated and their operations are so unified that we can scarcely think of them as distinct parts which have been able to get on together by reason of improvements in corporate organization. Yet our life is at bottom cell life, and all our activities of body and mind are the result of the coördinated functioning of the component cells. Moreover, these cells begin their existence in comparative independence, and differentiate, specialize, and merge their interest and find their several places and functions as the body grows.

The grades of organization among cells and the resultant forms of animal life are not more diverse than are the forms of political organization which have accompanied the social efforts of mankind; and the parallelism between the two is so close and so detailed one can scarcely doubt that broad general principles of organization are involved. With increasing size both have developed media of exchange, channels of transportation, lines of communication, supporting structures, organs of outlook and centers of control. Tasks have been differentiated and division of labor has made each part to bear responsibility for the welfare of all.

Parallelisms have always indicated conditions set by nature; conditions to which all organisms, whether physical or social, must conform in order to live.

In every organization, whatever its components, *mutual dependence is the strong bond of union.* This is the first condition of peaceful and permanent association. Unfortunately, it is wholly at variance with what have heretofore been national ideals of self-sufficiency. If each nation had to continue to raise, to mine, to manufacture all that its own people require for sustenance, and had to maintain defenses adequate to meet all comers, then permanent world peace would be forever impossible.

The road to world peace runs in the opposite direction. Let the peoples of the earth make common cause of their needs of defense, as the parts of the body have done; let them remove all artificial barriers to the fullest and freest use of the world's diversified products. Let them *organize an agency of control* to determine local conflicts of interest in accordance with the greater good: then peace will be possible.

In union, strength is found. By cooperation, the common tasks of life are more easily performed. But increase in the mass makes for better living only as the parts of the mass come to func-

tion together harmoniously, and each bears its share in meeting the common needs. *Mutual responsiveness* is the true measure of organic efficiency.

Peace is organic health.

If any organization is to attain to a high degree of efficiency its parts must be mutually dependent, having need of one another; mutually responsive, serving one another; and there must be also some organ of control, capable of determining for the sake of the larger interests of the body that local and private quarrels shall cease.

The human race at large is unorganized, inchoate. Its elements are combined in heterogeneous units of varied size and composition that are not consistently either racial or geographic. It resembles a slime mold rather than a vertebrate, since the mass may be divided and its parts may be recombined arbitrarily.

And yet, out of the mass there have emerged groups highly organized and highly efficient. The primal group is the family, firmly founded upon the one differentiation that Mother Nature has imposed upon us—the differentiation between the sexes. Combinations of families into clans and tribes grow out of the discovery of the advantages of coöperation in large tasks. Boundaries are at first determined largely by kinship, or by advantages of trade. With progress in agriculture and handicraft further compounding becomes possible and nations are organized. Always the size of the group is directly related to conditions of living: complexity of organization follows upon increase in size. But, large or small, every group that has attained to communal efficiency has followed the lines laid down by nature for all the living.

From the dawn of history even to this present hour the most marked psychological characteristic of all groupings of mankind has been the behavior of group-members toward one another as contrasted with their attitude toward outsiders; brotherhood within, enmity without. Federation, whether of families, tribes, or nations, has made for peace and coöperation inside the group, and for war and conquest outside. The closer the neighboring groups and the stronger their internal organization, the more intense has been their strife.

Every group has exalted its own heroes, traditions, folk ways, and looked down upon those of other groups as inferior. Whoever we were, we were the chosen people. Others were benighted in proportion as their ways diverged from our own. We have thought it our mission to extend our own kind of culture throughout the earth. This has been the spirit of nationalism; and it differs not a whit from the spirit of warring tribes in savagery.

Yet every organized group is a peace unit, within which comradeship, law, and order naturally develop. And with the progress of knowledge especially in agriculture and the arts, groups have grown larger and more inclusive. Living has been made easier. Substantial benefits to vast populations have come through federation; and wars, if more severe, have become less frequent. And now that science has brought the ends of the earth near together by means of rapid travel and instant communication, the conditions are ripe for a world-wide federation, and a new peace pact that shall include all mankind.

Such a pact will succeed if nature's laws are observed in the making and in the administering. In my judgment, it is of far less importance where national boundaries are drawn than how they are afterward maintained: it will not be a serious matter if "subject peoples" be included within those boundaries if only these be given freedom, security, and responsibility under their own government.

If human society is ever to become efficiently organized, it must *develop an*

organ of control. Before the Great War started we had the beginnings of a process of efficient organization of the world: we had international postal regulations, international copyright, and many international organizations, mostly without authority although not without influence. These had arisen as naturally as did the scattered ganglia of the lower animals, and like the ganglia they exercised separate and local control. Now that the war is over, these need only to be connected more intimately by means of a higher control center. Let the nations of the world make common cause of all their common interests.

The changes necessary are not greater than, nor different from, those that have taken place in the organization of tribes into a nation. The larger union that shall include all mankind needs only what the successful tribe or the successful nation has had in the past—needs only what the successful animal body has had—an organization of its units for mutual labor and mutual benefit. Mutual dependence, mutual responsiveness, government for the sake of the governed; these are the conditions set by nature for the making of an effective organic union: they are as inescapable as the law of gravitation.

THE ALTAR OF LIBERTY

Dedicated not to honor, not to vainglory, nor to personal pride; dedicated to the one great thing that marks the great man or the great nation, to the ideal of sacrifice. The Altar of Liberty in Madison Square was the great rallying point for New York City's mammoth celebration at the opening of the Fourth Liberty Loan on September 28, 1918. Vice President Marshall dedicated the Altar, which upon subsequent days was visited and decorated by the representatives of all the Allied Nations, including Ambassador Ishii, of Japan, and Sir Henry Babington Smith, British High Commissioner, who brought the message of "sacrifice" for a common cause

The Method and the Knowledge of Science

KNOWLEDGE GAINED BY THE METHOD OF INTUITION IS UNSATISFACTORY; THE METHOD OF SCIENCE IS THE ONLY SOURCE OF TRUE KNOWLEDGE IN THE WORLD

By WINTERTON C. CURTIS

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FOREWORD.—When the scientist discusses the philosophy of science he often makes himself ridiculous to the philosopher. Still philosophers as often seem ridiculous to scientists, and the danger is not in being laughed at, but in the continual neglect of discussion that takes us beyond our immediate fields of thought and investigation. The biological scientist is keenly alive to the problems of philosophy, because thought appears to him a product of evolution; and because, in his studies in embryology, he has long realized that one of his ultimate problems is the relation of mind and matter. Without apologies to the philosophers, we shall, therefore, set forth a creed to which we believe many biologists subscribe. If this meets with criticism in place of agreement, we shall be satisfied; for we desire rather discussion than enforcement of particular views. These are problems of human interest and are in the back of every scientist's mind whether or not he subscribes to the interpretations here presented.—THE AUTHOR.

The Method of Science

ANY man is a scientist when he puts two and two together and draws conclusions which are justified by the observed facts, for science uses only refinements of the inductions and deductions practiced in everyday life. The method of science is what Huxley described as "trained and organised common sense."[1] The man of the street or farm has a deal in common with the scientist, although the latter may seem to him both fool and dreamer. Let us consider this proposition that the method of science is but an extension of the method of common sense.

As there may be some question regarding the meaning of the term, we may agree at the outset that a man has common sense when he deals rationally with the facts of his experience. The phrase is sometimes used in derision, to contrast the sense of the everyday man with that of the theorist to the disadvantage of the latter. Again, it suggests something held in common by a large number of persons, or the sense of the common people. When analyzed, does the phrase not mean, that the man of common sense sees the whole situation or, as the scientist might put it, considers all the data and draws his conclusion therefrom? We think a man's judgment sound because he does what another would do, if confronted with the same situation and possessed of like ability to think straight. The theorist fails if he does not consider the workaday elements of the case, and the practical man if he judges solely by rule of thumb without the light of theoretical considerations. A man with the gift of common sense should know enough to consider both sides. Now science has gone forward in the past, not by any wizardry, but by the application of trained and organized sense in the solution of its problems; and the methods of thought which advance science do not differ in kind from those of the most hard-headed man of affairs, who creates from insignificant beginnings a business of international proportions.

For illustration, the owner of a quarry uncovers a layer of rock different in appearance from any before offered for

[1] Huxley, Thomas H., "On the Educational Value of the Natural History Sciences," pp. 38–65, *Science and Education.*

sale in his locality. Lacking expert advice, he begins experiments and observations, with a view to determining its utility for building purposes. After subjecting the stone to different tests, he concludes it can be put to certain uses. It is good for crushing and rough masonry, but not for sills and lintels; good for road foundations, but not for surfacing; and the like. In reaching these conclusions, he first establishes certain facts, then compares these with facts previously known; then classifies the stone as good or bad for a given purpose; and finally arrives at the proposition that a stone of this nature may be put to such and such a use. He is now in a position to convince would-be purchasers of the excellence of his material. Even an Indian, selecting the flint for his arrow points in the same locality years before, might have gone through similar mental processes.

If we compare the sense of science with the foregoing, the case is as follows: A geologist examines the same rock layer, because of peculiarities which have attracted his attention. He first makes a survey of the entire bed, collecting the fossils and observing structural features, comparing as he does so the present bed with others he has seen. Ripple marks and mud cracks may tell of shallow water, the fossils may indicate a marine origin, the distorted bedding planes may give evidence of lateral pressure. At last, he classifies it as belonging in a particular horizon and arrives at the proposition that stone of this nature belongs to a certain period of the earth's history. In such a case, the geologist believes he has reached conclusions obvious to others and is ready to take his colleagues over the ground, exhibiting facts and explaining inferences.

The quarryman goes through similar mental processes, did he but know it, although he is likely to go astray because his knowledge of rocks is after all rather limited, and because hope of gain is his sole incentive. The only advantage the geologist has is his broader knowledge and his desire to establish the facts rather than to line his pocket. The point for us is the parallelism between the mental processes of the two men, which are in essence the inductive method of science. The method of Sherlock Holmes would be a case in point, easy enough when you see the steps to the conclusions, and valid in so far as the original facts are unshakable and the inferences therefrom logical necessities. Every one who reads of Holmes's exploits sees that his mental processes are but an extension of everyday observation and inference, and so it is with science. Indeed, some teachers advise students to read classic detective stories, as good examples of the process of scientific induction.

The distinctive feature of the scientific method may be characterized by the adjective "common," if we use the word as meaning "shared equally or similarly by two or more individuals." For the common sense of science is that kind of sense which may be "shared" by normal members of the human species. It is not the whim of one individual, but the opinion held by all normal individuals when confronted by the same or a similar set of facts.

Before developing this, we should recognize three possible objections to the statement that the conclusions of science may be shared by all in common. First, the fact that many people hold a belief is no evidence of its validity. We no longer think what is "believed always, everywhere and by all" to be necessarily true, as did the early Fathers; for "all" may labor under similar delusions and hold the same unwarranted belief. If common belief were scientific evidence, then prenatal impression and telegony are facts overwhelmingly established in

man and the familiar mammals. Second, some one may ask, who are the "normal" individuals? To which we can best reply with the old Quaker's remark to his wife, "All folks are queer but thee and me, and I sometimes think thee's a little queer." A third objection must be answered at greater length. It may be asked, in view of the frequent differences of opinion among scientific men, whether any such thing as a common interpretation of phenomena exists. To which we answer, there is this common interpretation with respect to certain phenomena.

To illustrate specifically, it is a familiar fact that all living bodies are composed of units known as cells. The exceptions to this cellular organization of protoplasm, such as multinucleated cells, plasmodia, syncytia, etc., can all be brought into alignment with the general theory of nuclear and cytoplasmic materials. There was a time in the history of biology when nothing of the sort was known, and later, a time when a hypothesis of the universal cellular organization of protoplasm was proposed on a basis of limited observation. This working hypothesis was for a time debatable. But the increasing number of cases in which cells were observed soon led to its acceptance as an established generalization, now to be designated as the cell *fact*, since it is hypothetical only when we assume, as we do in the erection of our cell theory, that all living things are constructed after this fashion whether we have examined them or not. We have studied hundreds of thousands of living things and found them all composed of cells, and we assume that we shall always find cells as new animals and plants are examined. The phrase "cell theory" is like the phrase "theory of gravitation," theoretical only when we assume it will hold good elsewhere or when we push our analysis further and theorize about underlying causes. No one disputes the existence of cells, nor the assumption that we shall find them as long as we use microscopes, any more than he disputes the universality of gravitation, because of which we assume that stones thrown from the ground always come down whether in California or Japan or on the planet Mars. There is then common agreement regarding the existence of cells and the agreement extends to many details of their structure and activities, as for example that all cells contain chromatin or that all cells take in oxygen.

What we mean when we say the cell theory meets with common acceptance is that every one who has taken the time and pains to examine living tissues with the microscope, has observed the cells; that we ourselves have seen them; and that our contemporaries tell us their experience is like our own. There is, therefore, among the competent, a consensus of opinion represented by the cell theory, in other words, a "common" sense in which this phrase is understood. The only way this sense differs from that of persons without biological experience is that it rests upon wider observation and is, therefore, the more reliable. It happens that these conclusions regarding cells may be drawn only by persons trained to the use of microscopes; and only after special preparation of the materials examined, which is an illustration of what Huxley meant by "trained and organised" sense. It is not that the observations and conclusions of science are fundamentally different from those of everyday life, but that they are refinements of these, made possible by the training of the scientist and the organization of his material. There is no necromancy in science, for the methods by which science has advanced are the methods which normal individuals regularly use. Science has often made initial strides through the work of investigators who perceived the unifying fea-

tures in large series of phenomena, and whose daring hypotheses were like the flight of the poetic imagination or the vision of some genius of the commercial world. But what finally counts is the confirmation of each such hypothesis step by step, until it becomes a commonplace, verifiable by anyone who reviews the facts at first hand.

This refinement of the technique is the essential difference between the scientific and the popular method of drawing conclusions. In fixing the ice cream freezer or the furnace, one may be exercising a very common kind of sense. But it is a sense which differs from that exhibited by the scientific investigator, only in so far as the facts examined by the investigator are the more complicated and can be approached only after extended preparation. The man who builds a concrete sidewalk in his yard learns by experience and experiment, and by thinking things out as he goes. The man in an engineering experiment station, who is trying to advance our knowledge regarding the chemistry of cement, does essentially the same thing. Only he begins far ahead of the untrained man and, having a broader knowledge, recognizes possibilities of error the other does not comprehend.

By these and similar illustrations, it is seen that there is nothing unique in science or in the methods of science. Scientists are not wizards, but men who apply to natural phenomena the methods of analysis used by logical minds in the affairs of daily life. The facts of science are shared by all who possess the training necessary for their apprehension. We believe, moreover, that any normal person who trains himself to examine the facts will subscribe to our common agreement. If there is debatable ground and difference of opinion, it is because science no sooner gets a fact tolerably well established than it goes after other facts. While we agree upon the interpretation of certain data, conflicting data may be adduced at any time; or we may undertake entirely new lines of investigation, which at first yield uncertain results. Having satisfied ourselves as to the general epigenetic course of development and having a common agreement regarding this, we press on to something new, like the problem of fertilization or of differentiation. And here we are on ground where the facts are so poorly established we do not find a common sense in which to formulate a theory. There are divergent views in science, only because the essence of science is progress, and because we are interested in the things to be done rather than in those already accomplished. Apparently divergent opinion may eventually result in agreement once the facts are adequately known.

The differences between the main branches of science further illustrate our point. Physico-chemical science deals with comparatively simple phenomena, and has, therefore, reached an advanced position. The biological sciences, having all of chemistry and physics, and in addition the complexities of living matter, have developed slowly and today present relatively less common ground than physical science; while in the social sciences the complexities are further increased by the most unpredictable element of all—the intelligence of rational human beings. Hence there is not much "common" sense in sociology and none in religion and philosophy. Some, indeed, question whether within these fields we can ever reach common agreement except in their simpler categories of fact. We can at least try, and keep trying. For of one thing we are sure, human progress has not come by intuition, but by intelligent analysis, which is nothing less than saying by the accumulation of facts and by their interpretation in the common sense of science.

The Knowledge of Science

A recurring obstacle to scientific progress is the belief, born in a new guise with every age, that we can *know* things in some occult fashion aside from the evidence of our senses and the process of reasoning. Belief in this efficacy of divination and kindred arts appears well rooted at the beginning of history, and the success of fortune tellers and quack physicians and spiritualists attests its survival to the present day. Even the educated incline toward mysticism and intuition, upon slight provocation; while among the uneducated the influence of such beliefs is a potent factor. As a race, we are not yet convinced that we live in a universe where things do not happen by accident but through adequate causation.

Among our forefathers, these beliefs were even more widely held, and one of the silent victories of science has been the liberation of civilized man from superstitions that once held him in bondage, restricting alike his spiritual and material progress. Glimpses of the past may be caught in nations less advanced than those of western Europe. Thus, one cannot read a book like Professor Ross's *The Changing Chinese* without being convinced that the Chinese of today are in the mental condition of European man in the Middle Ages, with the burdens of witchcraft, of sorcery, and of belief in ghosts, lying heavy upon them; and that just as medieval man emerged from this slavery of soul so the Chinese will, doubtless, emerge in the future. Only their progress seems likely to be the more rapid because of contact with the western nations. We pride ourselves that we have gained so much and even boast in the strength of a supposedly superior race; and yet our civilization is honeycombed with superstitions, which hamper the best of us and which are a grievous burden upon the less fortunate members of society.

While the biologist must consider these cruder thought-survivals, as they affect those he seeks to influence through teaching, he needs, on his own account, to consider other mental processes, which, despite their refinement, are opposed to the advance of science. For example it has been often insisted by philosophers and others that scientific knowledge is only secondhand knowledge, that there is a method of reaching valid conclusions other than that of science, that intuitive processes yield even more certain truth than do the methods of science. The word intuition has had a variety of meanings, but in general is applied to a faculty for understanding things quickly without due process of reasoning,—to a kind of royal road toward the solution of any problem. Without venturing within the mazes of philosophy, we may consider the intuitive process as it is paraded in everyday life. Here, as with the philosophers, intuition is regarded as a mysterious short cut by which one arrives at conclusions, without the labor of drawing logical inferences.

When we consider the intuitive process, the following propositions are evident: Intuitions are effective only within the field of complex phenomena; they are most emphasized by persons not in the habit of careful analysis; they were formerly applied to many phenomena since brought within the grasp of science. All of which leads us to suspect that the matter is reducible to the proposition: What is simple we reason out; and what is complex and, therefore, not susceptible of exact analysis, we settle by a mental process of the same order as the "hunch" or the "lucky guess" of the plain citizen. A century ago, even a generation ago, an appalling amount of medical diagnosis rested upon an intuitive foundation. Today, an increasing amount rests upon a scientific knowledge of organisms and specific substances with-

in the body. The history of science is filled with such examples of the unknown and supposedly unknowable of one age becoming the known and the controlled of the next. This being so, is it not a fair presumption that what we decide today by intuition may, at a later day, be brought within the ken of science, and thus the realm of the intuitive become a lessening one, its name synonymous with the unknown or incompletely known, not with the unknowable? Is it not that we have intuitions regarding what we do not as yet understand, and that intuitions fade where scientific analysis establishes a foothold?

A banker does not decide whether a company is fairly capitalized, nor does he keep his books, by an intuitive process. He does these things by painstaking arithmetic. But he may loan money to one man rather than to another, because of an intuitive feeling that the one will meet his obligations while the other will not. Intuition, which in such an instance is probably nothing but "subconscious experience," probably tells the banker that one man "couldn't lie if you paid him," while another deliberately misrepresents the facts. Without believing that psychology will shortly relieve bankers and administrators of their need for intuitions, we may nevertheless regard such cases as susceptible of formulation in terms of heredity, environment, and in the vasomotor responses which psychologists are today postulating for all liars however calm to outward appearance. Even with our present knowledge, we can conceive of the banker's decision resting upon a complex of understandable phenomena of which he is unconscious at the time. For just as we judge distances by imperceptible or unrecognized changes of the eye muscles, or hit a billiard ball by motor responses of almost unbelievable delicacy, so the banker, who gives his answer as soon as his customer has finished speaking, may have his decision unconsciously influenced by the stimuli coming to him from the flicker of a muscle, a twisted phrase, or a look in the eyes, as well as from grosser matters like the man's reputation or the principles of safe investment. In a word, I can well conceive of the analysis of thought processes, as physically expressed, some day reaching a point where many things now vague and incapable of analysis will be reduced to scientific statement of fact. It may never be well for a banker to put his customer through a machine test. A good judge of character can perhaps do the work more expeditiously, and well enough for banking purposes. But in war we are coming to select certain mental types for certain duties under the advice of our psychologists. And I see no reason why chauffeurs, and engine drivers, and even honest men may not be so chosen at some time in the future. What this means is that mental behavior, once regarded as beyond the domain of science, is being shown to follow a causal sequence in a few cases. But we see no reason why these few cases should not be extended to include an increasing number of mental phenomena; and if this happens we can set no limit to the banishment of intuition as a source of knowledge regarding human behavior.

Other examples might be given. An investigator does not draw the conclusions his experiments justify by intuitive processes, although his speculation may be of this nature. A teacher comes to a mastery of his subject only by its methodical organization. But in the vague state of our knowledge concerning effective methods in education, he may say he has an intuition for the presentation which makes a lecture acceptable to his students. If a man is in the habit of speaking to the dogs he passes on the street, even calling them from a distance, he is sometimes pleased at his success in

manipulating dog psychology. He might call it intuition as to how dogs will react. But it is possible that the man "sizes up" his dog, much as we unconsciously measure distances with our eye muscles, and tries the stimulus likely to work. The dog's reaction is very complicated. It depends upon his past experience with strangers, upon his training at home, upon his experience with this man, upon his hereditary make-up; and yet it is by no means certain there are elements involved which can never be analyzed by science. If a man knew all these facts for a particular dog, he might be able to predict what response would follow a given stimulus. And if the dog could be as well informed, he might know what to expect from the man.

The biologist neither affirms nor denies that such a series of phenomena as the dog's reactions will some day be thus analyzed. He does not know. He is making some headway in explaining animal behavior in these terms, and so long as he can make headway, he hesitates to set limits to his future progress. Life is not likely to become stale in the near future because all things have become predictable in scientific terms. We shall continue our inroads upon the intuitive process for a long time without exhausting the residuum. Only, so long as we can see a receding vista ahead, it takes boldness to assert the existence of a remainder not susceptible of scientific treatment. We may well question whether intuitions are in any sense a method of acquiring knowledge, whether they are knowledge at all, and whether intuition means anything but ignorance of complex phenomena, however effectively it seems to fulfill its functions in a given instance.

Another weakness of our intuitions is their individual bias. They are the product of a single mind, not the collective agreement of individuals who have examined the same data. As such, they are open to the suspicion of being influenced by delusion or prejudice. Moreover, they work differently with different persons, exhibit to a large degree the personal equation, and have all the "ear marks" of processes which are not and never can be reliable as methods of thought.

The scientist, therefore, believes the method of intuition wholly unsatisfactory as a source of knowledge. When he says he "knows" a thing he means that any normal individual, who puts himself under similar conditions, will receive similar sense impressions and will draw the same conclusion. The scientist does not claim to know everything. He does claim that the intuitions of daily life are not knowledge, in the scientific sense, for they presumably represent either the vagaries of the individual mind or thought processes too unorganized to be used as a basis for knowledge.

Neither is the "intuitive knowledge" of religion or philosophy to be placed in the same category with the "common" knowledge of science. For this, like the intuitions of daily life, rests upon no safer foundation than the caprice of the individual mind. If a field of mental activity does not permit a beginning of organization in terms of common assent it is not subject matter for science, and is, therefore, not a matter of which we can have knowledge in the scientific sense. The scientist protests against dignifying individual opinion by the term "knowledge," which he reserves for conclusions resting upon collective judgment. It is the contention of science that its method of "common" sense is the only method which has yielded knowledge of permanent value, that the only thing we can designate as knowledge is reached in this fashion. Other brands are the whims of individual minds, and can never be substituted for the one kind of knowledge which is the knowledge of science.

Courtesy of Paul G. Howes and the New York Zoölogical Society

FEAR DOES NOT QUICKLY OVERCOME HER BROODING INSTINCT

Hoactzins look more or less like pheasants. They are very quarrelsome among themselves, however, and when pugnacious lose all resemblance to any other living bird. They erect the plumed crest, spread wide the flapping wings, and with strange flouncings and contortions, hiss, grunt, and croak in a high key. The utterances of an excited colony blend into an indescribable confusion of sound, sometimes as doleful as though the birds were mourning for all the extinct of their race. That this species has endured so long may be owing, at least in small measure, to the strong fetid odor of the adult bird. Hoactzins have feeble wing muscles and fly only short distances, across the stream or from point to point along its banks. They wander little, therefore, and unlike most birds can always be found in the same locality every month of the year

The Hoactzin—Only Survivor of an Ancient Order of Four-footed Birds*

Discovery of the quadrupedal character of the young, and first-hand observations on habits and home of the species

By EDWARD M. BRIGHAM

Curator Public Schools Museum, Battle Creek, Michigan

IN April, 1881, while collecting vertebrate embryos in the interior of the island of Marajo, at the mouth of the Amazon, I discovered that the young of the *Opisthocomus hoazin* is distinctly quadrupedal.[1] Toward the end of incubation two toes on each forefoot (wing) were so completely produced that I was confident they would be functional in some manner after the birds were hatched. A little later I saw the birds actually using the toes, and using them in a highly significant way.

The adult bird has long been known to science. It is known on the lower Amazon by its Portuguese name, *cigana.* It has also a long list of local names as each tribe of Indians in the Amazon Basin has a distinct language. The species is generally known as the "hoactzin." It is of such size and its habitat is so exposed that it could not have escaped the notice of anyone traveling far along the Amazon. But the remarkable quadrupedal character of the young bird had hitherto not been observed. The adult hoactzin, in size and general appearance, reminds one of a pheasant although it bears no near relation to that bird. In fact it has no near relatives living—it is the sole surviving species of the order Opisthocomi, an order of which geologists have found fossil representatives.

The hoactzin may be described briefly as pheasant-like in size and aspect (about 21–25 inches from tip to tip), with a very dull coloration above of varying shades of reddish brown streaked with dirty buff — and buff below.

The hoactzin is gregarious. Its habitat on the lower Amazon is limited by a single species of plant—*Caladium arborescens,* called by the natives *aninga.* This plant is a tall amphibious aroid, related to the jack-in-the-pulpit and the calla. It has large heart-shaped leaves, calla-like flowers, and fruit remotely resembling a pineapple. The plant often grows to a height of fifteen feet, but averages perhaps eight feet when fully grown. It forms in dense masses on the low, flat, muddy margins of the islands and borders of the water courses, frequently standing many yards out in the muddy shallows.

Imagine a broad hedge of tall stout-stemmed *aningas,* with a score or more of hoactzins scattered over the top, seated on the leafstalks and feeding on the leaves of the plants, or making their way with flounces and hisses from one plant to another, and you will have something like a picture of this strange bird in its lower Amazon habitat. I never saw the bird alight on the ground. Although the *aninga* leaf is a frail and yielding perch, the hoactzin seems to prefer it to any other. The bird

[1] The discovery that the hoactzin is functionally quadrupedal during a part of its life, was announced by the author of this article, in a paper read at a meeting of the Chicago Academy of Sciences in 1884. The paper was published in full at that time in the *Chicago Tribune.* (Oct. 18, 1884.)

* With illustrations from *Tropical Wild Life in British Guiana,* through the courtesy of the Author, Mr. C. William Beebe, and of the New York Zoölogical Society.

Courtesy of Paul G. Howes and the New York Zoölogical Society

A typical haunt of the hoactzin, Canje Creek, British Guiana.—In this locality the species is now protected by the British Government, a special fine of five pounds sterling being imposed for killing one of the birds

builds its nest of twigs and other coarse vegetable matter in the *aninga* tops and in overhanging branches of trees or matted vines. It does not leave the water margins. Only on rare occasions, as when one is tormented beyond endurance by its fellows, does it venture into the forest and then not so far but that a few flaps of its wings will place its feet on the yielding, swinging *aninga* leaf again. There it rests its breast on the bent leafstem and hisses, tottering awkwardly with outstretched wings and tail until the *aninga* ceases swinging. The habit of steadying itself on its perch by squatting on its breast has caused a thickening of the skin, a piling up of epidermal tissue into a hard callosity which is so firmly fastened to the bone that a strong knife is needed to separate it when removing the skin. The hoactzin is so accustomed to squatting on the *aninga* that even when on other perches it is rarely seen erect. I have never seen it fly farther than across a narrow stream, from one *aninga* hedge to another.

The hoactzin is a very quarrelsome bird. When its pugnacity is manifest, its pheasant-like appearance vanishes, and it then looks like no other bird. It erects its sparsely plumed crest and awkwardly flaps its wings while trying to keep a balance on the unsteady perch. It throws its neck into contortions as if it were really choking, and in a ludicrously awkward manner menaces its fellow, which is having equal difficulty in retaining its perch while retaliating from the swinging leaf of a neighboring *aninga*. While the birds are thus strangely gesticulating, the noise of their flapping wings is accompanied by hissing, grunting, roaring, and shrieking. There are times of general uprising when the mingled utterances of the colony make a confusion unearthly and indescribable. Sometimes they join in most doleful sounds as if suddenly moved to mourning for all the extinct Opisthocomi. Periods of general and extreme demonstration usually occur in the night. Such is the resemblance of some of their cries on these occasions to some of those of the jaguar,

that upon being awakened by them I have reached for my rifle and held it in readiness until other and characteristic sounds followed which assigned the cries to the medley of the hoactzin.

One day in June, on a later expedition, when paddling along the margin of the lower Rio Negro, the natives pushed our canoe into a strip of marginal *igapo* or flooded forest. The water was well up into the tops of the trees. Hard-featured alligators gurgled, grunted, and roared as they slunk away among the half-submerged tree tops. Huge iguanas, which were basking and feeding in unusual numbers on the topmost branches at a height of from ten to twenty feet above us, started suddenly from their perches and plunged headlong through the branches into the *igapo*. I never witnessed a more interesting reptilian scene. Interest in the situation was greatly heightened by the presence among the topmost branches of the flouncing and hissing hoactzins. As I was aware of the reptilian suggestions in the birds' anatomy the scene was to me impressive and significant. I

Courtesy of C. William Beebe and the New York Zoölogical Society

The *aninga* (*Caladium arborescens*), characteristic of the hoactzin's haunt, is related to the jack-in-the-pulpit and the calla. It forms dense hedges averaging eight feet in height along the muddy banks of streams, often growing many yards out in the shallow water. In a scene like this there might be a score or more hoactzins perched in the tops of the *aningas* or flying awkwardly from one plant to another. The curved stem of the large leaf is the favorite perch of the bird, where, however, it must squat close to balance itself. The bird's breast where it presses against the plant has a hard callosity, a thick cushion of epidermal tissue, so firmly grown to the bone that in skinning a dead bird a knife is needed to separate the skin from the bone at this point

felt that I was witnessing the nearest approach possible in this age of the world, to a typical Mesozoic scene. While intent upon these incidents, my attention was suddenly diverted from the upper to the lower branches by a plunge different from that of the iguana —as if some animal had toppled off the lower branches into the water. In the near vicinity of the plunge I saw a young hoactzin seated on a low branch. Then my natives said it was a young *cigana* that had toppled over into the water. I told them to shoot the remaining bird. They shot, but the bird plunged and we did not see it again. Soon, however, we saw the first bird emerge and climb from the water on to a dipping branch on the farther side of the tree top, and *it climbed on to the branch on all fours.* An Indian shot the bird and I preserved its skin. With the bird in hand I showed the natives the *front* feet. They expressed astonishment, and after some reflection an old man said, "The young *ciganas* climb out of the water with those feet." Evidently the presence of the toes on the fore limbs explained a performance with which he was familiar although the modus had hitherto been a mystery.

As the anterior limbs are functionally scansorial during a considerable part of their post-oval growth, we should expect them to attain only the low degree of volery power which they possess. The wings of the adult bird are exceedingly feeble. The sternum is without a keel. It does not seem possible that the young birds could raise themselves from the water in any other way than by climbing. If the wings had sufficient power it seems certain, in view of the fact that the feet are webless, that the young bird would use its wings to enable it to escape from its enemies, rather than to attain safety by plunging into the water.

The geographical range of the species has been given as the "estuaries of the Amazon and mouths of the lower tributaries of that river and the Orinoco." My observations however show a vastly wider range. I shot the hoactzin in Peru, 2100 miles up the Amazon, and I saw it still farther up the river, probably to within 350 miles of the Pacific. It certainly has an east and west range of more than 2000 miles. Its Amazonian range appears to be coextensive with the flood areas of the great river and its tributaries. Although the flood season varies greatly between different parts of the hoactzin's Amazonian range, I found that throughout the length of the vast region in which I observed the bird, its breeding period was coincident with that of the floods. The broods invariably develop through the functionally quadrupedal stage before the water becomes too low to afford the young a retreat from danger. Hence it is clear that the young birds are absolutely dependent upon the water beneath their perches for safety. The relatively inflexible conditions of reproduction restrict the species to its marginal habitat during the flood season—its breeding season. The conditions appear to be even more restrictive for, from all my personal observations and inquiries, the bird does not leave the margin during the time of low water. It may be found along the margins of the main river and its tributaries, along the margins of the innumerable side channels and the confluent lagoons, or places where there are lagoons in the flood season. I cannot find that it has ever been seen away from the borders of streams, or some opening in the forest which is occupied by water during the whole or part of the year, and which directly or indirectly opens to the river. The hoactzins are not known to wander.

The place farthest from the mouth of the Amazon in which I found the hoactzin was nearly dry. There was too little water for the young birds to dive in. It was a mucky swale a stone's throw in length and hardly half that in

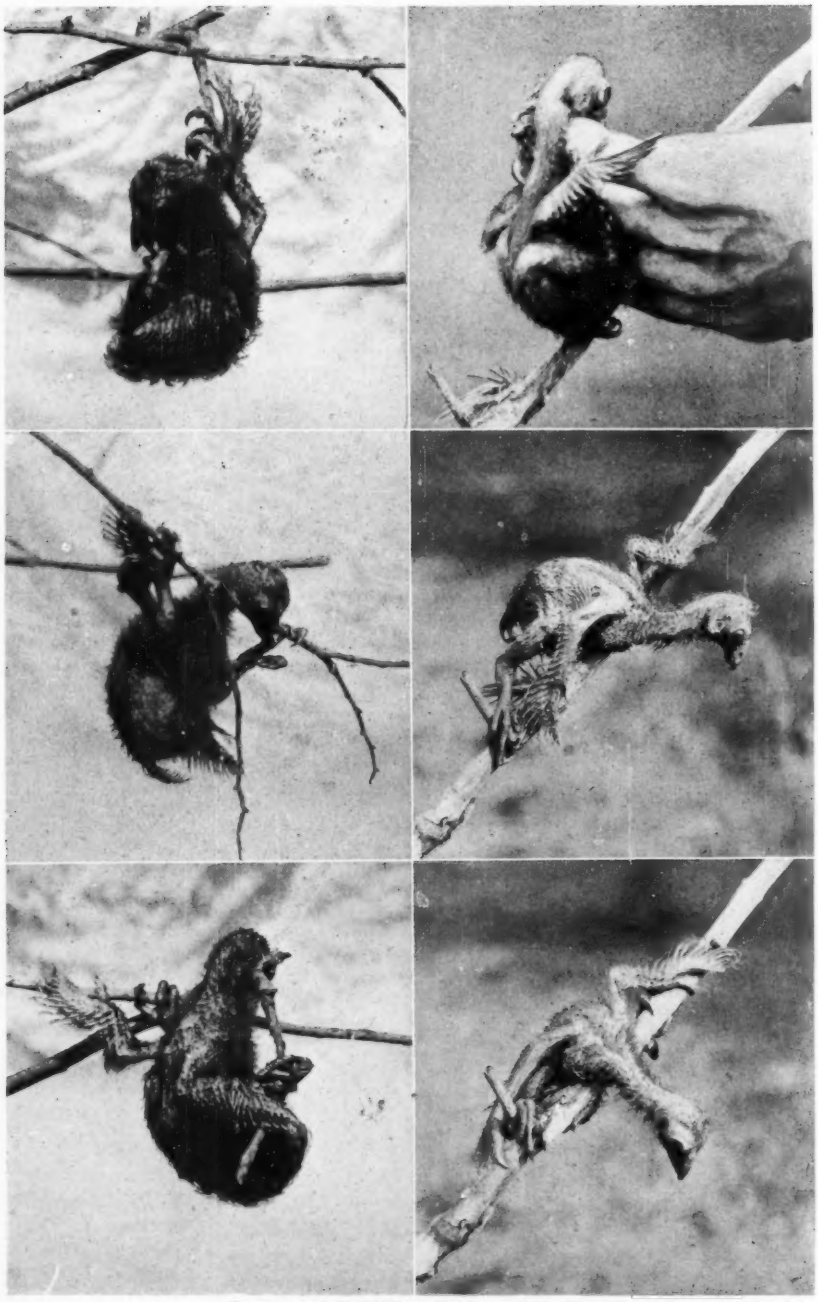
Courtesy of C. William Beebe and the New York Zoölogical Society

The hoactzin invariably builds its nest out over the water, either in the *aninga* tops or in the overhanging branches of trees or vines. The breeding season is coincident with the rains and high water in the streams. The nest is made of twigs and often rests on the foundation of an older nest. It has scarcely any depression and would seem to be a place of uncertain safety for the eggs

breadth. I saw this place early in the season of low water. Later the little swale may have been quite dry. But the broods of the season had matured and there was evidently no need of more water until the next flood season, the next breeding season of the bird. There were several nests among the branches, always overhanging the swale. There were no young or eggs to restrain

Courtesy of Paul G. Howes and the New York Zoölogical Society

Before the young hoactzin hatches from the egg, the wing (or forefoot) shows two toes well developed, and within twenty-four hours after the bird is hatched the two toes are functional—the bird is distinctly four-footed and proceeds like a reptile or mammal and unlike any other living bird. The long safety of this species in South America is probably largely the result of the young bird's instinct when threatened by danger to clamber on all fours to the edge of its flat nest and *dive* into the water below. Thus becomes evident the value to the species of the coincidence in the development of the young through this four-footed stage and the time of high water in the stream above which the nests are built



Courtesy of C. William Beebe and the New York Zoölogical Society

THE YOUNG HOACTZIN IS FOUR-FOOTED LIKE A LIZARD

Studies of a young hoactzin to illustrate its ability to climb by means of feet and neck and especially through use of the two toes developed on the wing. After a young hoactzin has dropped into the water under its nest and the danger is past, it proves its four-footed character by climbing out of the water on some branch, using the two toes of the front feet (wings) as vigorously in the performance as it does the four toes of the hind feet

the birds, but, although, I shot into them repeatedly and from all sides, they would not leave the marginal vegetation. It seemed evident to me that the muddy swale marked the place of a former lagoon which was connected by an open channel, or *igarpe,* with the river, and that, in the ceaseless and rapid shifting of lines of water, land, and trees of the Amazon Basin, the lagoon had been landlocked and then diminished in area by each succeeding flood deposit. The question arose as to whether the bird could get away,—whether, as the opening in the forest closed, the little group of hoactzins would not dwindle with it and become extinct.

The Amazon flows near the equator and subparallel with it. On account of this position the gradational work of the river is of a magnitude disproportionate even to its relative size. The rains follow the sun and according as the sun is in either tropic, the northern or southern tributaries are swollen and their respective flood areas covered. The immense volumes of water poured into the main stream from one side shove the current strongly against the opposite bank, and at times even force the waters of the sluggish tributaries upstream—an estuary action of these annual "tides." During the flood season long strips of forest are cut down by the force of the current pushed against its borders; hundreds of acres in a linear body are often cut away by the resistless current. At times the great stream is so filled with floating vegetation resulting from this havoc that navigation is impeded and becomes dangerous to light craft. Occasionally great masses of matted vegetation supporting erect trees of considerable size may be seen. There can be no doubt that these floating islands detached from the river borders transport hoactzins from upper to lower positions along the river. Such mingling of stock might explain the fact that the species exhibits little if any variation in its vast Amazonian range. The great range is doubtless due to the simplicity, continuity, and extent of the general conditions of the habitat, together with the frequent accidental transportation of the birds by drifting marginal vegetation from one to another of more or less widely separated points, a process which must have endured through a long period of time.

Also, a very slow migration upstream is not impossible. Doubtless the fluctuations of the river bring about topographic changes destroying the congenial marginal conditions of the established location of a colony. The hoactzin rendered homeless by such a catastrophe would doubtless clumsily flop its way to another favorable place on the river margin, and this might, of course, be upstream. There is nothing to prompt the bird to wander or to induce regular migrations—its food is always ready and the rainy season is its breeding season.

The lowering of the water leaves a more or less extensive tract of mud outside the marginal vegetation so that the water is separated during the dry season from the habitat of the hoactzin. But I have never seen the adult bird reach the ground or approach the water. It is a remarkable fact that such a weak-winged, defenseless bird, in such an exposed habitat, has escaped extinction in a region abounding in powerful Raptores and other carnivorous enemies. A means of preservation is suggested, however, by the marked fetid odor of the adult bird. The young are protected by immersion, and later, as the bird approaches maturity, it acquires this offensive odor.

The hoactzin represents one of a group of vertebrate types of vast geological antiquity which constitute a marked characteristic of the fauna of South America. A long isolation of the continent has been inferred from the persistence of these old types.

NOTES BY A COLLECTOR IN THE COLORADO ROCKIES

BY ALBERT E. BUTLER

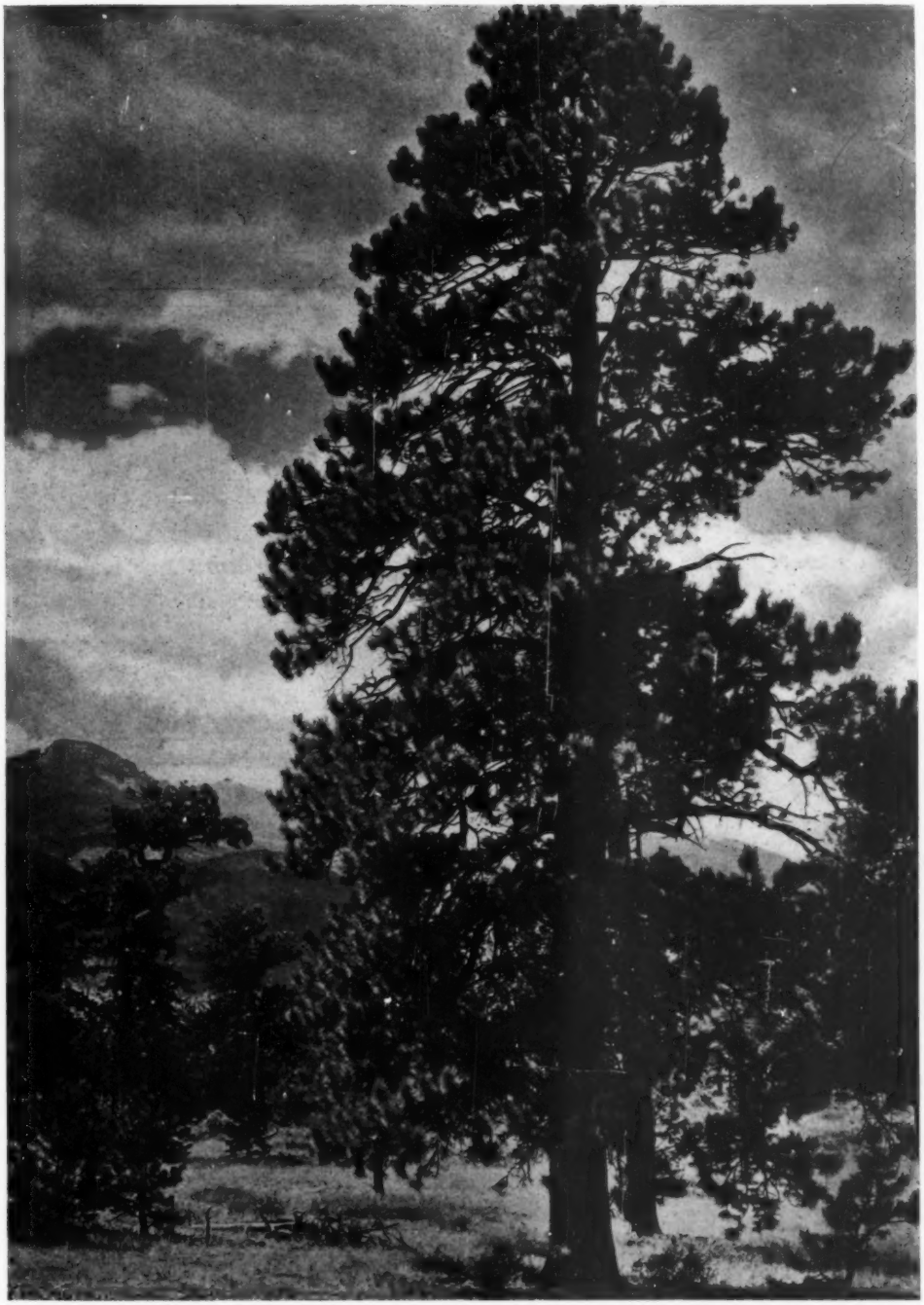
With a series of illustrations from photographs by the Author

LONGS PEAK AND THE CONTINENTAL DIVIDE AS SEEN FROM ESTES PARK[1]

The Front Range of the Colorado Rockies with its crest of perpetual snow stands as the most eastern outpost of the Great Divide. From the point where this picture was taken Longs Peak appears as a rather smoothly rounded mountain, but from the top of the Divide it is seen as a great square block of granite. Its crevices are filled with snow where the wind has not blown this away, and down its side flows a small glacier, the last remnant of an ice sheet which piled the huge moraine in the valley

[1] Of the many natural parks of Colorado, Estes Park has been the one most frequented as a resort. The magnificent cañon of the Big Thompson River admits the autoist or tramper entering from the east, but the way to the south and west is barred by the precipitous rise of the Great Divide, at this point a veritable wall rather than a range. The valley of Grand Lake, whose waters flow into the Colorado River, lies only thirty-five miles westward.

In 1915 the Longs Peak region, about 229,000 acres including part of Estes Park, was established by the Federal Government as the Rocky Mountain National Park and forms, with Mesa Verde Park in the southwestern part of the state, one of Colorado's two large national preserves. It is fairly accessible by a number of railroads, but sufficiently remote always to insure its beautiful wildness



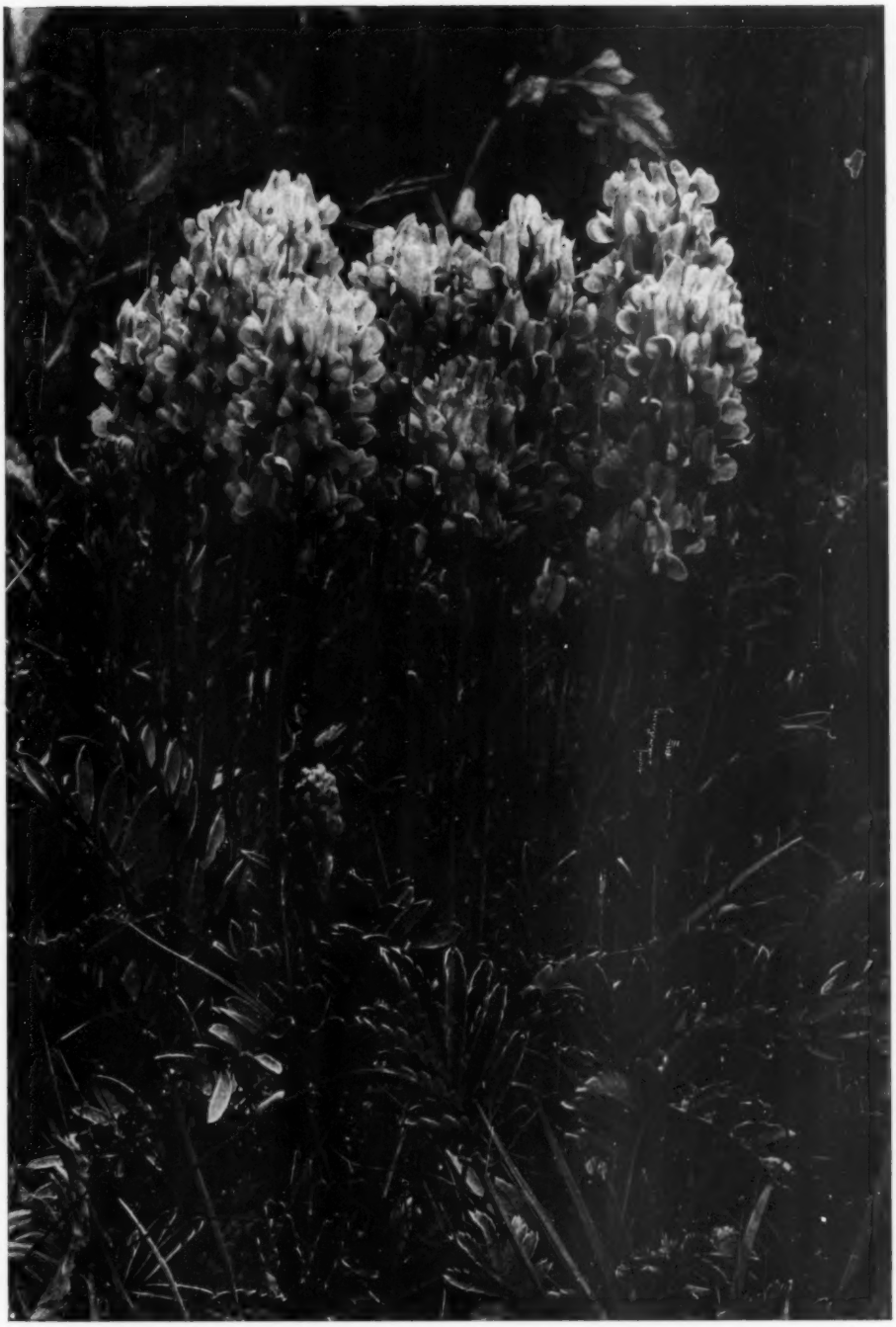
SYMMETRY OF THE ISOLATED YELLOW PINE

Perhaps the most picturesque of Colorado trees is the Rocky Mountain yellow pine (*Pinus scopulorum*). It occurs on the plains southeast of Denver up through the foothills to as high as 9000 feet. At times it is found in forests but it reaches its greatest growth when more or less isolated. It is capable of more diversity of form than perhaps any other of the pines, sometimes taking on a most grotesque appearance and again exhibiting a perfect symmetry but always fitting into the beauty of the landscape, as is evidenced by its frequent use as a subject by painter and photographer. Its commercial value is very great as it produces more high quality lumber than any other tree in the state

A WILD FLOWER OF THE COLORADO ROCKIES

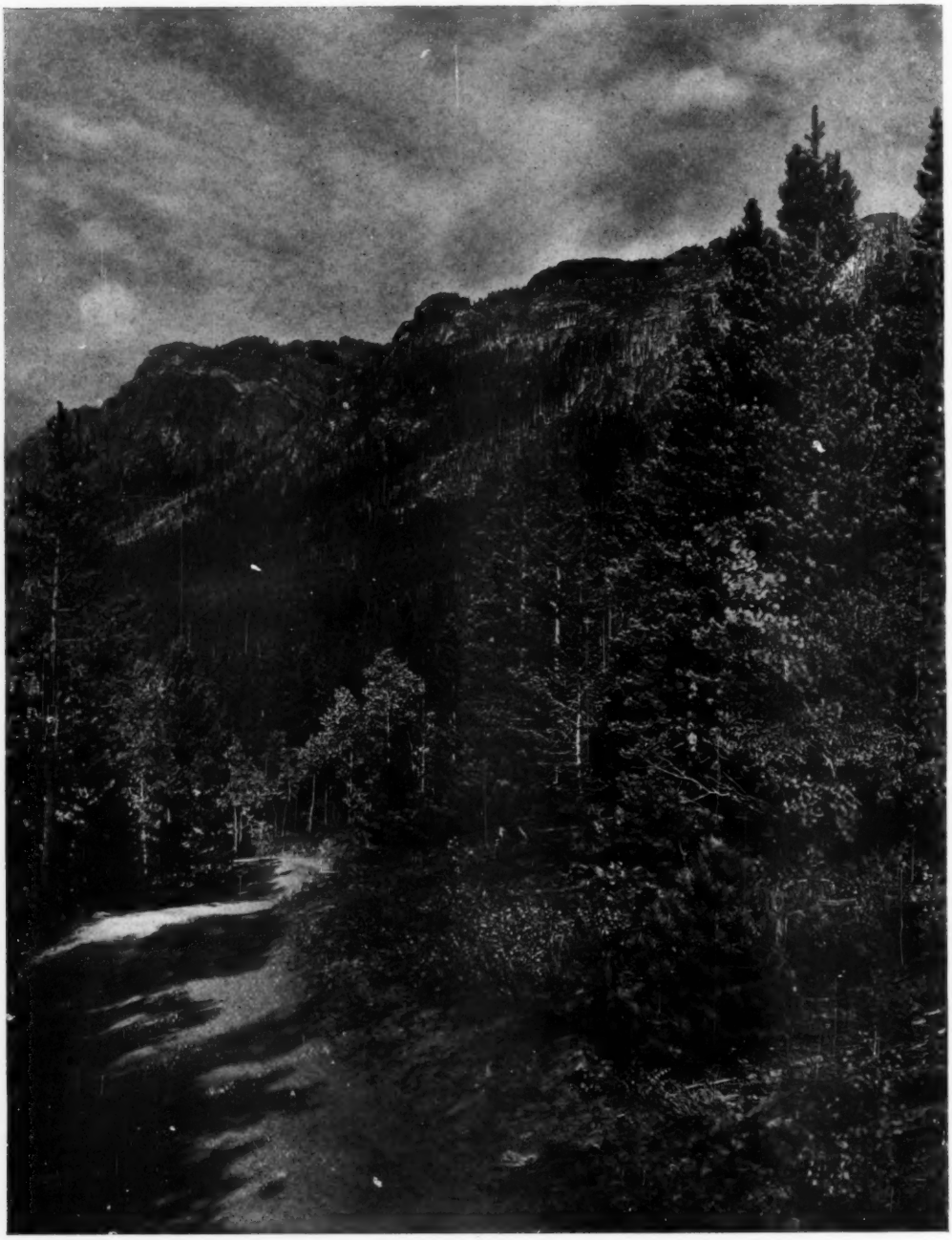
One of the delights of travel in the Rockies of Colorado is the abundance of wild flowers. Sixteen hundred varieties are accredited to the Estes Park region alone. The showy yellow, purple, or variegated gaillardia is well known in the florists' shops of New York and other eastern cities. In season one may gather an armful of it along the Colorado roadway in a very few minutes, and it is a sad fact that this is too often done, for the enthusiasm of the visitor at seeing the conservatory door open and the sign of welcome out overcomes his better judgment and he picks until there is not a flower left in sight. Much propaganda for the protection of the wild flowers, however, is being spread, and it is hoped that no species will be entirely destroyed.

Some of the most delightful spots in all Colorado for wild flowers are found on the slopes of Lookout Mountain immediately back of the town of Golden. It is a commendable tribute to the population of this little mountain community that wild flowers are still to be found in abundance right at their back door. As Golden is now a gateway to Denver's wonderful system of mountain parks, these wild flowers add much to the charm of the seventy-mile trip that tourists enjoy



IT CLOTHES THE MOUNTAIN MEADOWS IN PURPLE

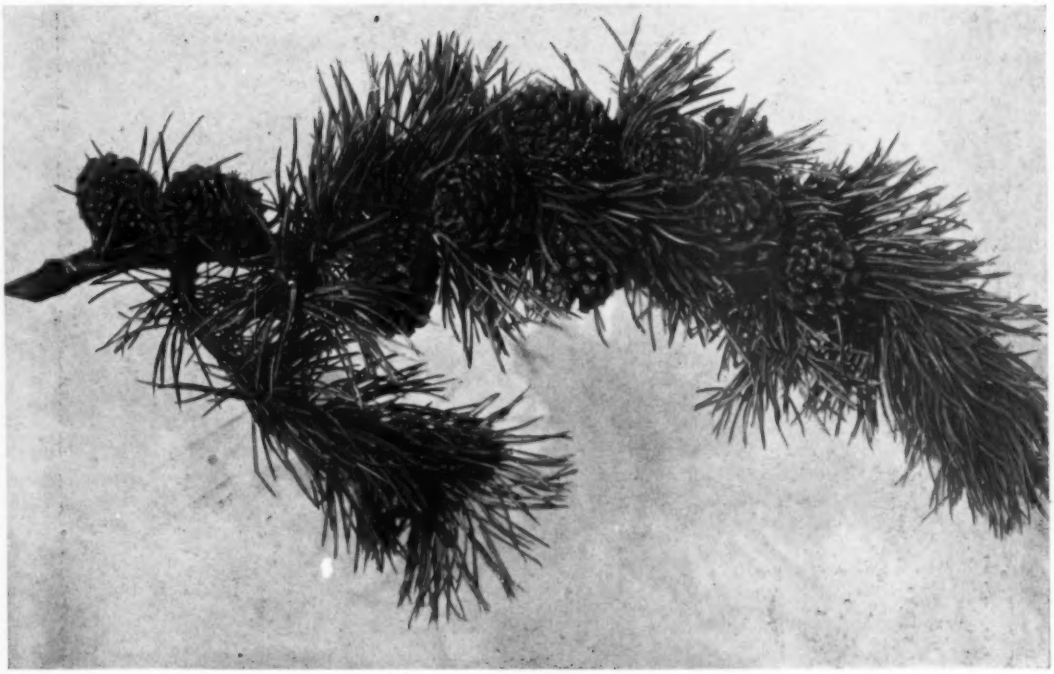
There are several species of loco commonly found in the Colorado Rockies, all of which grow in the open along the roadways or in the meadows of the parks. The most common is a brilliant purple variety (*Astragalus nitidus*) which sometimes covers the meadows as thickly as does the familiar field or ox-eye daisy of the Eastern States. The variety shown here is quite the most handsome of its kind both for its size and color. The flowering heads are from six to eight inches in length and the individual blossoms full half as large as a sweet pea, the color varying from a greenish or pure white to a delicate purple. A moist meadow profusely carpeted with this mountain flower in all its many hues is a veritable fairyland of beauty



A ROADWAY, AND LODGEPOLE PINES AT HIGH ALTITUDE

Lodgepole pine (*Pinus murrayana*) is probably the most common and typical tree from 9000 to 10,000 feet altitude. It forms the most dense forests of the Rocky Mountains, sometimes being almost impassable even to the traveler on foot. The beautiful, tall, slender trunks make excellent material for the woodsman's cabin, and in fact this tree was used by the Indians in erecting their tepees. Now it serves for telegraph poles, railway ties, fence posts—and wherever long straight timber is desirable.

Mountain roads make the Rockies of Colorado easily accessible for the autoist, even into the very high altitudes in some localities; but the traveler who wishes to see and enjoy these great hills will take his pack upon his back and brave the lodgepole forest and the rocky cliffs. If he is alert, he will be well repaid for all the discomfort he may suffer, for there is no region in all our land so full of interest for the nature lover



A WELL-FRUITED SPRAY OF THE LODGEPOLE PINE[1]

On exhibition in the forestry hall of the American Museum of Natural History

The lodgepole pine often forms mountain woodlands which seem unending, and the man who has ventured off the beaten trail to cross a belt of lodgepole, can testify to the density of its growth

[1] *The story of its collecting.*—The greatest surprise that awaits the collector of tree specimens in the Colorado Rockies is the distance one must travel to find them. The wooded hills apparently have no bounds and there are vast tracts of dense timber, but a tract miles in extent may afford only one or two species.

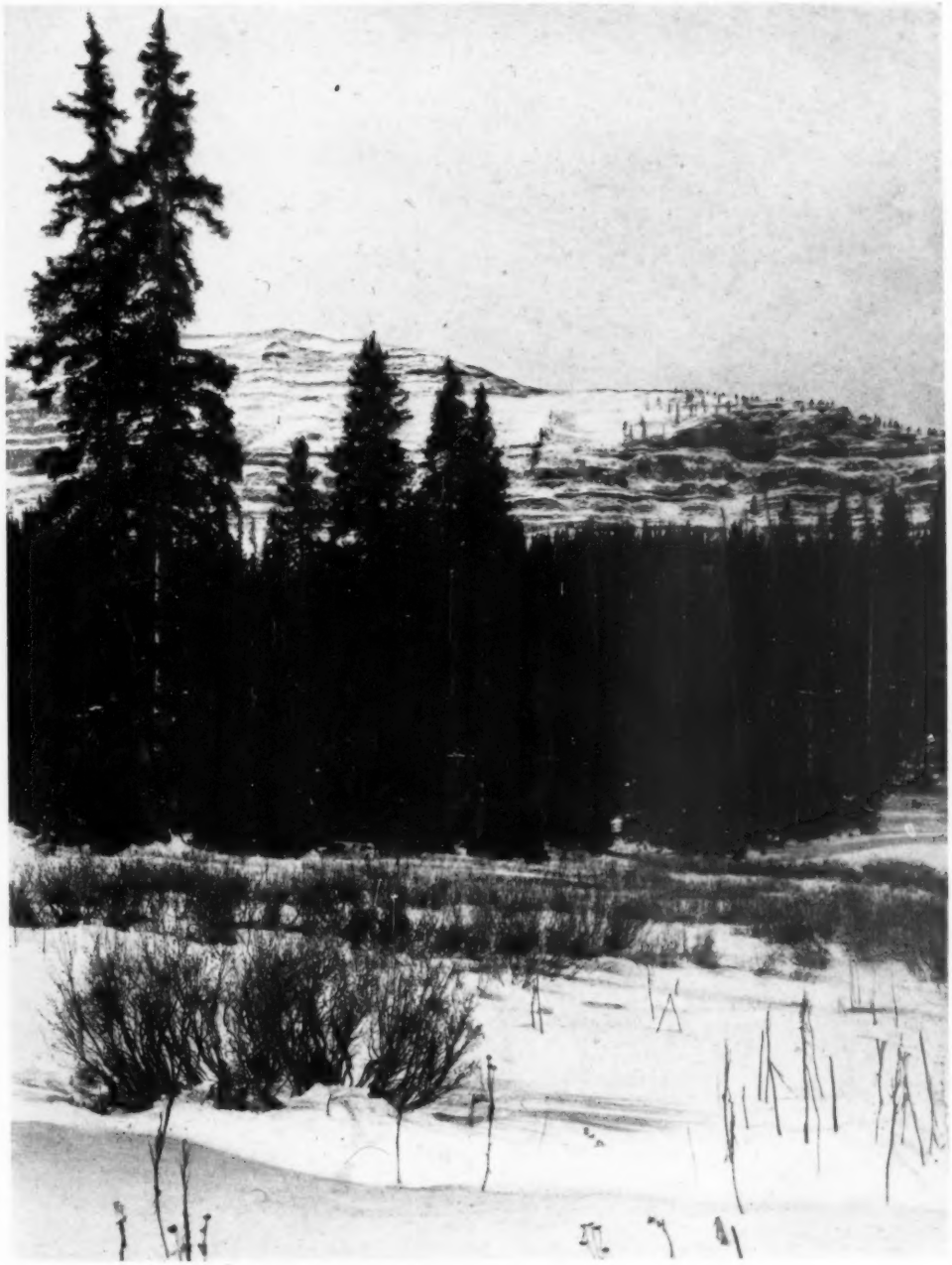
One day in August I made an early start from Estes Park, about 7500 feet elevation. A trail breaks from the roadway a short ride beyond the village. It soon leaves behind the scattered western yellow pines, and at about 8000 feet abruptly enters the dense growth of lodgepole pine. Here the trail becomes steep and rugged, rising 2500 feet in about three miles, and wanders back and forth over the rocky wooded slopes, sometimes following for some distance a wild, rushing, snow-fed stream. The object of the trip was often interrupted by the sight of a deer or the flushing of a grouse, and my attention continually wandered with delight over the unexpected gardens of wild flowers.

The lodgepole forest which began so abruptly at 8000 feet ended in the same characteristic manner at about 9500 feet, where the trail breaks into the spruce and fir belt, reaching to timber line which in Colorado is about 11,500 feet. Thus far I had seen but the two species of pine, the yellow and the lodgepole. Well-fruited specimens of these were located but were not collected until we were homeward bound, so as to subject the branches to the least possible jolting. The latter part of the climb was made difficult and uncomfortable by a rain cloud which enveloped us so that at times we could see but a few yards ahead. This made it hazardous to wander into the woods far from the beaten, crooked path, and although the trail was lined with Douglas fir and Engelmann spruce for some distance, we were unable to discover any well-fruited sprays. A good specimen of the alpine fir was taken, however, and, once out of the higher hills, we were in sunshine again and in no time were back on the picturesque lodgepole trail, where the exceptionally fine branch shown above was collected.

Entering again the region of the Rocky Mountain yellow pine, we picked up our previously located branch and hurried on our way in order to pack for shipment the specimens we had collected. The process of packing for the long trip to New York required care, but as little time was lost as possible in getting the specimens to the village express office. I learned with satisfaction a few days later that this package had arrived at the American Museum in perfect condition after its 2000 mile journey. The sprays can now be seen on exhibition in the Jesup collection of woods of North America.—THE AUTHOR.

THE MOUNTAIN FOREST IS HOME TO THE PINE SQUIRRELS

The pine squirrel abounds in the thick woods as is evidenced by the frequent piles of scales from the pine and spruce cones on which he has fed. Whether his excited chatter is a warning to the other animals and bird folk that there is an unwelcome visitor in their forest is not clear, but it is certain that the collector who may be looking for a pine squirrel will have no trouble in locating the object of his search. The little fellows do not readily become accustomed to campers as do many other small animals and birds. The chipmunk is very friendly after the first day or so, the pack or trade rat is notoriously familiar, and the Rocky Mountain jay or "camp robber" has a reputation not less unenviable. Larger game is plentiful and the camper's sleep is often disturbed by the howl of a coyote or, if it be in the fall of the year, by the whistle of a big bull elk, and either will send a chill up the spine of the uninitiated



THE WARDENS OF THE LOST LAKES

Dense forests of Engelmann spruce act as wardens of the Lost Lakes which lie hidden among them. This is at the foot of Flat Top Range in the Wild Basin region of Rio Blanco County. "Lost" the lakes are, indeed, and remote from roads, or from trails except of deer, elk and mountain sheep, so that even old woodsmen at times have difficulty in searching them out. The height of the distant range can be appreciated from the fact that it is more than a mile from the far edge of the forest to the foot of the range and that the rise at this point exceeds 3000 feet, entirely too precipitous to permit of scaling it from this side. In the foreground is seen the scrubby willow on the tender buds of which the ptarmigan feeds in winter. The first heavy snow usually falls in late October

"ADDER'S-TONGUE" COVERS THE HIGH SLOPES WITH YELLOW

A variety of adder's-tongue (*Erythronium parviflorum*) found in the Rockies differs from the eastern form in that the flower is pure yellow and the leaf a light monotone green. Near timber line it literally carpets the mountain-side in places. It startles the traveler who, climbing along the woodland trail which suddenly breaks through the last belt of timber, sees what appears to be a vividly yellow mountain. The brilliancy of the golden yellow in the sunlight is beyond description. *The Spell of the Rockies* is the title of a book on travel in the Rocky Mountains,[1] and to anyone who has traveled these hills the expression is full of meaning. We do not need to climb to the top of the highest peak and look across the endless chains of hills and down upon the rest of the world to experience the thrill; the "spell" comes with the ever-changing variety and beauty of the scenery and the wild life

[1]*The Spell of the Rockies*, by Enos A. Mills. Published by Houghton Mifflin Company. Mr. Mills has explored the Rocky Mountains alone and on foot for many years, especially in the vicinity of Longs Peak. He has written books and articles and given many addresses advocating conservation of life and scenery and is known as the "Father of Rocky Mountain National Park"

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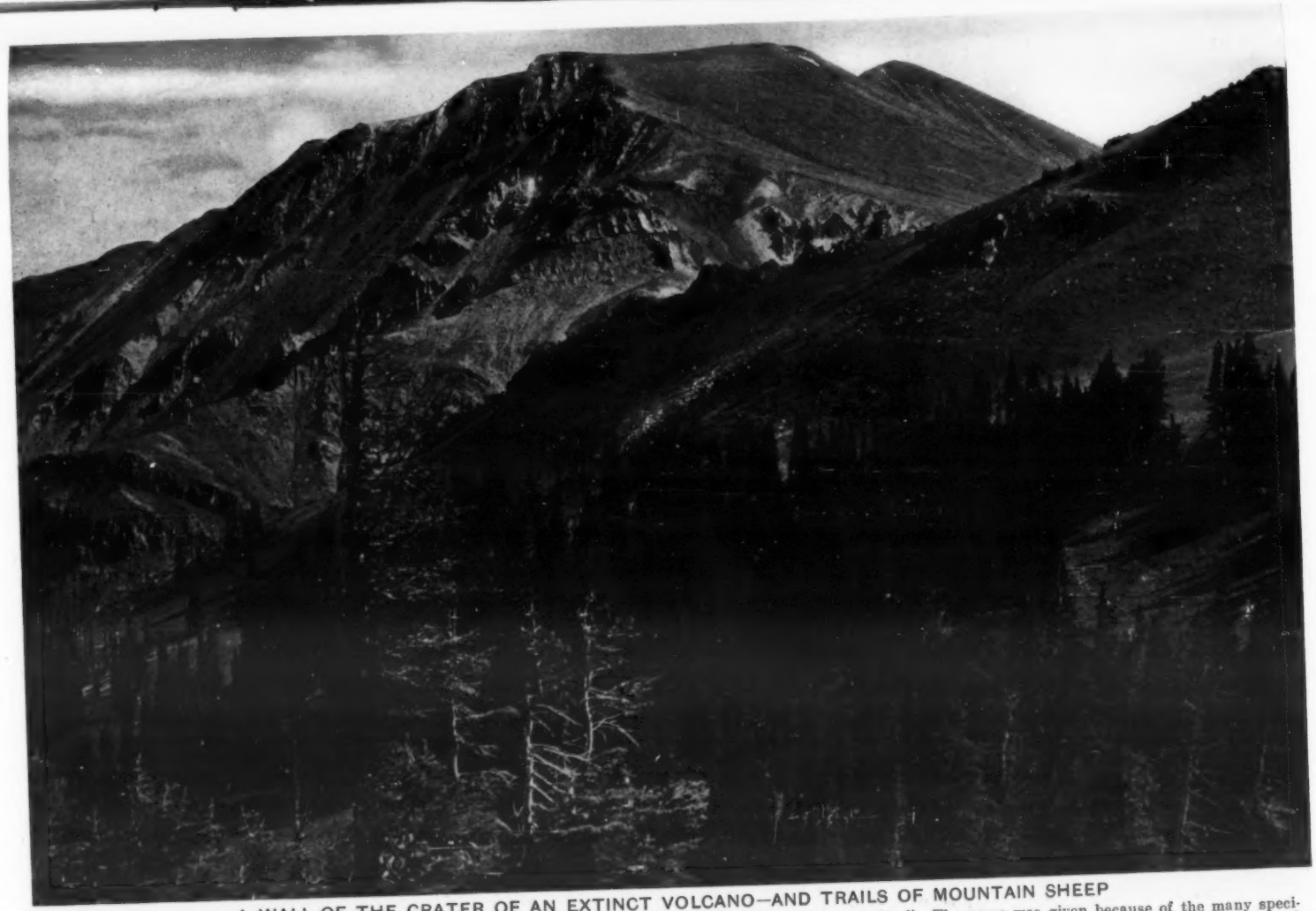


A WALL OF THE CRATER OF AN EXTINCT VOLCANO—AND TRAILS OF MOUNTAIN SHEEP

On the extreme western border of the new Rocky Mountain National Park are the "Specimen Mountains." The name was given because of the many specimens of geodes found on their western slope which forms a part of the wall of the crater of an extinct volcano. Grotesque formations of rock in vivid and varied colorings rise out of the steep slope of the crater like ruins of an ancient city and give an interest to the scene which is otherwise quite desolate. The greater part of the crater lacks entirely the vegetation which is so profuse on the mountain slopes. In spite of this fact one may at any time see here several bands of mountain sheep for the spot is admirably adapted to their protection. The slopes show a veritable network of sheep trails, plainly visible in the picture. The piping of a cony or the whistle of a marmot is the only other sign of life in this great "hole in the earth," yet there is an interest about it all which attracts the visitor, and he might easily spend a whole day walking about in it and return yet again and again

THE GLORY OF SUMMER TIME IN THE MOUNTAINS OF COLORADO

Perhaps nowhere else in all America is there to be found such abundance and variety of wild flowers. The species in the open spaces and along the streams differ from those along the wooded trail, and again the forms change at timber line. Here in Colorado, at about 11,000 feet, are veritable gardens of flowers which it would seem must have been arranged by a landscape artist. Even the upturned surfaces of rocks where slightly concaved and though several feet above the ground, have gained enough soil to serve as *jardinières*, and nature has not slighted the invitation. The beautiful blue columbine (Colorado's state flower), with the deeper blue of the larkspur, the rose-colored wild geranium, the wild buckwheat, and the painted cup, may dot a few square feet of earth like strokes of clear color from the painter's brush. One of the most interesting, from standpoint of variation in color, is the painted cup, which ranges from brick red in the lower altitudes to the most brilliant purples near timber line. One of the charms of mountain flower life is that so many varieties which bloom in the very early spring in the low altitudes are found several months later in full bloom in the higher parts. Thus the season for many of our most sought after flowers is greatly lengthened

ened

HUGE GRANITE ROCK PILES

Bordering the numerous parks and cañons of the Rocky Mountains, huge masses of solid rock are commonly found from the foothills to the tops of the highest peaks. The traveler soon realizes whence the name of this range has come. The rock is largely a coarse-textured pink granite, and gives to the landscape a delightful variation in color scheme. These huge granite piles the rock chuck, the pack or trade rat, and many other small mammals find excellent cover and make their homes there

Russian Explorations of the Siberian Ocean in 1918*

By A. W. GREELY

Major General, United States Army, Retired

IT is a special satisfaction to learn that the Great War has not entirely absorbed the activities of the world along scientific and adventurous lines. In recent years the hydrographic surveys of the Russian Empire, largely conducted along lines of operations devised by Lieutenant General J. C. Schokalsky, of the Russian navy, have been extended in their fields and important in their results. Summaries of such surveys have been correlated and published by Schokalsky both in Russian and in English journals. It is encouraging to learn that these surveys have been continued in 1918.

It will be remembered that in 1914–15 Captain Vilkitsky, commanding the ice-breakers "Taimyr" and "Vaigatch," made the first voyage of any kind from Bering Strait westward to the Atlantic Ocean.[1] Besides surveying the coast waters of the Siberian ocean, he had already added in 1913 two new islands to the New Siberian archipelago, which discoveries he now supplemented by a new island in the Bennett group, discovered by De Long in the "Jeannette" expedition, 1880–81.

Vilkitsky's great discovery was the archipelago of Nicholas II, directly north of Cape Chelyuskin. This archipelago extends about two hundred miles to the northwest, having been explored as far as 82 degrees north latitude, and 93 degrees east longitude. In his surveying voyage of 1914—when he sailed from Vladivostok—Vilkitsky endeavored to rescue the shipwrecked men of the "Karluk," then in great distress on Wrangell Land. The island was so surrounded by heavy ice that it could not then be reached. With him at that time were Lieutenants N. Evgenoff and A. Nikolsky, of the Russian navy, now on duty at the embassy in Washington. Later explorations of Nicholas II archipelago showed that one island was one hundred miles across from east to west, and its geological structure indicates clearly that it was, in earlier ages, a northerly extension of the continent of Asia.

General Schokalsky reports a renewal of the survey work in the Siberian ocean during 1918, and it is understood that expeditions are now in the field, although it is more than possible that recent war operations may have interfered with the work. The plans for these surveys were drawn by the Hydrographic Administration, the most active members being the Chief of the Administration and Hydrographer E. L. Bialckos. The western section of the expedition, working from the White Sea eastward to Cape Chelyuskin, remains under command of Captain B. A. Vilkitsky. The eastern expedition, surveying from Cape Chelyuskin to Bering Strait, is commanded by Captain P. A. Novopashhennij. Sea surveys will be supplemented by shore stations, where tidal, meteorological and other hydrographic observations will be made continuously for two or more years. The expeditions will be kept in connection with each other by radio shore stations, of which three have been in operation for several years: Jugor-shij, Karskia Strait; Cape Mare-sale, Jamal Peninsula; and Dickson Inlet. As soon as possible other radio stations will be installed in east Matochkin Shar, Obdorsk, at the mouths of the Enissei and Petchora, Nakhodke, Obi Gulf, the mouths of the Lena and Kolima, and at other less important points.

The scientific labors of the expeditions will be supplemented by such studies by experts as may serve to develop the great resources of Siberia from economic and commercial standpoints.

[1] See AMERICAN MUSEUM JOURNAL, Vol. XIII, pp. 347–49.

* This summary of exploratory work in the Siberian ocean was received by General Greely in a private letter from Petrograd.

Recollections of Travel in Peru[1]

By ROLLO H. BECK

ARMED with letters of introduction, I started out the morning after my arrival in Lima, early in January, 1913, with the hope of obtaining a government permit to collect a dozen or so of the innumerable shags or cormorants that had formed one of the sights of the day before as we sailed southward along the shores of Peru. As the Peruvian government derives a yearly revenue of many thousands of dollars from the sale of guano, the birds are carefully protected,—how carefully protected I did not learn for more than five months, at the end of which time permission to collect the birds was finally refused. Although I was introduced to the Government Minister by a leading official of the Peruvian corporation which had the concession for gathering the guano, and although the American Minister to Peru added the weight of his office to my plea, the weeks and months of waiting were in vain so far as government sanction was concerned. Between my semiweekly, weekly, biweekly, and finally monthly visits to the government offices to learn the progress of my petition, I spent my efforts collecting birds which were not government protected.

By far the most interesting birds to me in and about Lima were the black vultures. In California I was accustomed to the wariness of the turkey vulture, which seldom allows approach within shooting distance; therefore these tame scavenging birds in their relation to the sanitation of the city and country afforded constant surprises as well as considerable amusement. At one of the slaughterhouses of the city the birds sat around on the trees, roofs, and fences by the dozens, waiting for the killing of an animal that the health officer would reject as unfit for human food. The diseased carcasses would be hauled out into the street less than a block from the entrance to the yard, and the birds did the rest. One large fat hog disappeared completely in two hours, while a rather skinny cow lasted over night. The tameness of the birds was shown particularly along the railway embankment when the half-hourly trains between Lima and Callao passed. Of a dozen birds sitting on the sloping ground from three to fifteen feet below the rails, two thirds perhaps would fly off a few yards, but the others would remain while the train passed practically just above their heads. Out at Chorrillos, where I often collected, the trail I followed passed the city dump, and one could always see several black vultures walking gingerly about the burning piles of garbage, vying with dogs and pigs and sometimes a burro or two in picking out bits of food from the smoking heaps.

The country roads about Lima were often deep rivers of dust and I soon learned to follow the custom of the country in climbing up and walking on top of the wide adobe walls which are used both as fences and footpaths in many places. I remember what had been my amazement late one afternoon of my first trip into the outskirts of Lima, when, in looking across a small field of growing corn, I saw a large dog trotting along apparently on the top of one of the farthest corn rows. He jogged along unconcernedly and it was not until he passed beyond the cornfield that I saw he was on top of an adobe fence.

Several times the magnificent South American condors were seen between Lima and Callao, slowly circling high above their smaller relatives, the black and turkey vultures. By the end of February, no action having been taken on my permit, I decided to go up to Lake Junin for a month. Lake Junin is situated nearly thirteen thousand feet high and, in addition to being frequented by many of the high Andean water birds, is the home of two or three species peculiar to itself. Through the kindness of the president of the Cerro de Pasco Railway Company we were given the use of his shooting lodge close to the railway line a half mile from the lake, and this proved to be

[1] Peru, visited by Mr. and Mrs. Beck in the early part of 1913, was the first station on their five-year collecting trip to South America for marine birds. The specimens obtained on this expedition are now deposited in the Brewster-Sanford collections at the American Museum. Other accounts of Mr. Beck's experiences are given in the JOURNAL for November, 1917, and for January and February, 1918.

much more convenient than quarters in the village of Junin would have been. The cabin was fitted up with all the necessary articles for keeping house—with the exception of the stove. There had been a stove, but some enterprising railway section boss had carried it off to warm his tent somewhere up the line. Mrs. Beck therefore did the cooking in the fireplace. In walking down to the lake shore during the first week of our stay we saw many golden plover on the open tundra, getting in shape for the long flight to Alaska, where I had met their kind the summer before. Three other species of North American shore birds were also common about the lake, as well as the blue-winged teal, one of the North American ducks.

The most striking birds of the district were the flamingos. Standing in the doorway in the early morning we could see a pink line along the edge of the shallow water as the birds gathered their morning meal, and a little later, when the sun lit up the low, rough, snow-capped peaks of the Cordillera a few miles to the westward, we could see the flamingos take wing and fly on to some safer resting ground far beyond our vision.

Changes of temperature were very sudden about the lake. We might be rowing along, coats off in the bright sunshine, when a lazy looking cloud would come drifting over from the eastward. A chill wind would rise and in a few minutes a snow or hail squall would strike us and raincoats would be donned in a hurry, to be discarded probably a few minutes later when the sun appeared again. It is said locally that Lake Junin is the home of the largest frogs in the world.[1] I saw but one in the lake and then only for a moment as it came up for a breath of air and dived on seeing the boat; but later, at Cerro de Pasco, we saw a number hanging in the market place for sale, and I judged a single leg might be ample for a meal.

One Saturday afternoon we flagged the freight train and went up to Cerro de Pasco, which lies a few miles beyond the lake. We were greatly astonished as well as immediately appreciative when we were ushered into a steam-heated, electric-lighted room, with running hot and cold water and a porcelain bathtub. We found later that the railroad company maintains this building for its employees, and it certainly makes their lot much more bearable at that high altitude. One of the officials showed us about the immense smelter, with all its powerful, up-to-date American equipment, and, later, we had a chance, on the outskirts of the town, to watch the native miners bringing out in leather sacks on their backs silver ore from their small mine, as did their progenitors hundreds of years ago. Close by were other shafts equipped with modern machinery which made the contrasts more emphatic. Another remarkable feature of this barren, treeless, mountain top more than fourteen thousand feet high was the excellence and variety of fruits and vegetables for sale in the public market, all of them brought up from the eastern slopes of the Andes on burro and llama back or on the heads of the Indians. The oranges were sweeter than any we had eaten in Lima, the capital, and the variety of vegetables was fully as great. We walked out over the hill for a mile or so and looked far down a cañon to the eastward, through which a winding trail was visible, and we stood aside from the trail while a herd of llamas passed loaded with green fodder grown in the warmer cañons miles below us. The next day, after buying some bread and vegetables, we returned to our work again. When our diet of wild ducks or snipe palled on us, our Indian helper would go to some Indian village near by and purchase half a sheep, paying therefor seventy-five cents or a dollar, the price depending on the size of the animal. We often bought eggs also which were very reasonable in price. We were especially interested in one village boy about ten years old who used to come over frequently with his spindle and ball of wool which he industriously wound while watching us skin birds. He never made a sound, and each night when the sun went down returned home with a piece of bread and jam.

At the end of a month we packed up our birds and, hailing the freight train one afternoon, left for lower levels. About ten miles above Oroya, our destination for the day,

[1] These frogs, *Batrachophrynus microthalmus* Werner, although larger than our North American bullfrogs, are not nearly as large as the giant frog *Rana goliath* Boulenger, of Gabun, Africa. *Batrachophrynus* is related to the West Indian "bullfrog" but because of its aquatic habits has developed the general form of aglossal frogs and has lost all but the slightest trace of a tongue.

INDIAN VILLAGE BUILT OF ROCKS FROM THE SOIL

A short distance to the southward of Puno, on Lake Titicaca, is a rocky ridge on which is situated a typical Indian hamlet. The huts are built of the rocks taken from the soil and of mud, and are roofed over with the tough, coarse tules brought up from the lake shore. Affixed to each roof is a roughly made cross. Strongly built stone fences surround each house and serve as corrals for the pigs, cows, and llamas which during the day are grazing nearby under the care of some of the smaller Indian children. The soil is burdened with stones, so much so indeed that the pile removed from a plot in order to farm it sometimes covers more ground than the cultivated area. In all this region of the ancient Incas, about Lake Titicaca, the amount of work which has been done to enlarge and protect the cultivable land amazed us continually

the conductor slowed down the train and I jumped off to have my first and only experience with the rare spur-winged ducks. These birds live in swift, tumbling mountainous streams and can proceed upstream, under water, at a rate perfectly astounding to one unacquainted with them. I managed to secure a couple of specimens but lost several that were swept under the banks or through rapids where the eye could not follow them. I walked down the cañon which became continually wider, with small patches of ripening barley and of thrifty potato vines along both sides of the railroad track. Occasionally a patch only forty or fifty feet square would be seen fenced on all sides by a stone wall; one enclosure contained only five rows of ten potato plants each or a total of fifty plants, and I saw other patches with even fewer plants. Rotation of crops was followed evidently by at least some of the farmers, and the well-filled heads of barley were especially surprising at that high altitude, more than twelve thousand feet above sea level.

The journey from Oroya to Lima was enjoyed even more than we had enjoyed the upward trip. Being now accustomed to the thin air we were able to get out of the train at Ticlio, the highest point, 15,600 feet, and stroll about the station during the half-hour wait. Here, as at most other stations, a crowd of Indians had gathered to see the train arrive and depart. It was surprising at each station to see the number of the poorest natives that evidently had business at some station farther along the line. The second-class coaches were always full and, as we neared Lima, the first-class became crowded also. In dropping down the hundred miles from Ticlio to sea level more than sixty tunnels are gone through and more than sixty bridges crossed. In the same distance more than a dozen switchbacks are used to negotiate the steep cañon sides along which the railway runs. When one tires of

At one of the entrances to the principal market of Lima, Peru, it is often possible to buy freshly sliced pineapple from small boys who carry some dozens of slices about on large plates. Each piece is sprinkled with sugar before being delivered to the purchaser

At Cerro de Pasco, a few miles beyond Lake Junin, situated nearly 16,000 feet above sea level on the barren, treeless mountain tops, we found a wonderful display of fresh fruits and vegetables in the market place. All of these are brought up on the backs of burros and llamas and on the heads of the natives, from the warm eastern slope of the Andes thousands of feet below. It was here that we saw giant frogs hanging in the market place, so large that we judged a single leg would be ample for a meal. We remained a month in the high altitude of the vicinity of Lake Junin and studied and collected many species of mountain birds, especially ducks, snipe, plover, and other high Andean waterfowl. It was at a somewhat lower altitude, when we were on our way back to Lima, that I had my first and only experience with the rare spur-winged duck, a bird that can swim upstream in the swift turbulent mountain current at an astounding speed

In the small Andean villages it is often possible to get a whole sheep for a dollar from some farmer or his wife, who brings it in to town and sits patiently down in a likely spot until a buyer appears

We found burro loads of green alfalfa for sale at Salaverry, Peru. Alfalfa is grown everywhere up to an altitude of 11,000 or 12,000 feet, above which the traveler has to depend on dried forage or mountain pasture, unless, perchance, llama loads of green fodder have been brought up to the higher markets from warmer cañons below, as we found was the case at Cerro de Pasco. Both the burros and the alfalfa are Spanish importations into Peru, and are well adapted to the country

In walking toward the old cathedral from the hotel in Puno one will nearly always find a herd of llamas occupying a station in front of some one of the business houses. This photograph was taken in front of the American bakery of Mariano Barrasa. Puno lies on the edge of Lake Titicaca, and many water birds, such as mud hens and grebes, are brought to the Puno market by the natives. We never tired of strolling about this market place on Sunday mornings when the llamas came in loaded with varied produce and the natives haggled and bargained over their small purchases

looking across the cañon and counting the number of stone fences between the cañon top and the roaring torrent in the bottom, or trying to count the number of llamas in a flock as they climb some precipitous trail homeward, he can turn his eyes heavenward and watch the wonderful sailing of the great American condors as they

On Sunday mornings there is usually a fleet of twenty or more balsas tied up near this wharf at Puno. Early in the afternoon the owners begin to straggle down from the town and by sunset nearly all are gone, either poling along the shallow water or, if the wind is fair, using the crude sail made of dried tules which is hoisted only when the wind is abaft the beam. These native hunters obtain many ducks and other water birds in the clumps of tule at the margin of the lake and display them in the Sunday market of Puno. The birds are picked clean of feathers to the bill and sometimes partly cooked; they sell for about five cents gold each

circle about the cañon. Lower down in the foothills green orchards and plantations are passed and, as Lima is neared, fields of sugar cane and herds of feeding cattle greet the eye.

I was greatly surprised, the day after our return, on inquiring at the government offices, to find that no action had been taken on my application for the collecting permit. So, after working a week around Lima, we went up the coast some twenty odd miles to Ancon, off which are several islands where many sea birds nest. Here I obtained a fine lot of sea birds other than those government protected. There were three species of small petrels quite common five miles offshore and one of these species was nesting on one of the islands. I was interested to find, in collecting several dozen birds near the island, that nearly all were of two species not nesting there. The nesting birds probably went farther out to sea to feed, as they were found later two hundred miles from land. The commonest bird of the three species was Wilson's petrel, which nests hundreds of miles south of Cape Horn. During the Antarctic winter these birds come north on both sides of South America, on the Pacific side seemingly seldom above the equator, but on the Atlantic they are common visitants to at

least New England, and occasionally they are seen in New York Harbor.

Ancon was formerly thickly populated with Indians, and in the sand hills a mile or two back from the present town is a large cemetery which has been pretty well rifled for treasures it may have contained. We happened to discover the spot one hot Sunday afternoon while out for a walk, and our recollections of Ancon always bring back the memory of dozens of whitening human skulls, with a solitary, lonesome-looking Englishman ruthlessly knocking a golf ball over the sacred ground.

Our return to Lima was again characterized by a futile attempt to get a decision on our modest request, so a schooner was chartered for a month and we went out to sea to collect on the ocean. Fifty miles out and beyond, we encountered several species of ocean birds which usually do not come much nearer land except in the nesting season. One day I was out in the rowboat some distance from the schooner and just in the act of picking up a rare bird from the water when I was thrown backward by some object striking the boat underneath. Looking behind me, I saw a large shark making a dash for the boat. A strong jab with the oar disconcerted him a little but he rubbed himself a number of times on the bottom. I even reached over and scratched his fin, after I had observed that there were several small remoras bothering him. These little sucker fish hang very tenaciously to their host; about the Galápagos Islands in other years we had often hauled sharks and turtles aboard with several remoras clinging to them.

Near the end of the cruise we anchored one night below Pisco Bay some distance south of Callao. Parading along the shore of the quiet bay were forty or more flamingos in company with a great flock of shags, gulls, pelicans, and shore birds of several species. It was surprising enough to see the flamingos in such company, but it was more surprising to see four species of Alaskan birds back already on June 30 from their northern summer homes. The surf birds especially seemed out of place along the warm, calm waters of a protected shore. I associated them with dashing breakers and strong cold winds from the open ocean, for such had been their chosen spots when I had previously met them.

After the government powers had had my application before them for half a year they decided finally that permission could not be granted me to collect specimens of their guano producers, although all other birds were at my disposal. As I had, while awaiting this unexpected answer, obtained series of nearly all the other water birds in the vicinity, we took steamer for Mollendo, southern Peru, and went by rail up to Lake Titicaca where several desired species of birds were known to live. Before beginning our work at the lake we spent a couple of days at Cuzco, the Inca capital. Our ride up to Cuzco from Juliaca, the junction point, happened to take place during the festival season, and at several of the stations along the way groups of Indians were dancing and marching about the villages. Oftentimes women would be prancing and circling about, with heavy children bobbing up and down in the shawls swung over their backs. At one stop, a few rods from that station, we saw a pair of oxen tramping out a stack of grain quite in the fashion of a couple or more thousand years ago.

The astounding amount of work that has been done to enlarge and protect the cultivable area amazed us continually. One field of several acres I remember particularly, where the portion of the ground that had been made fit for use by the removal of the rocks was smaller than that covered with immense rock piles.

One or two of the old cathedrals in Cuzco have far finer hand-worked figures, chairs, and pews than are those of the many churches we entered in the other countries of South America. The beautifully mortised stones along some of the streets and the immense hand-worked rocks forming the walls of the old Inca fort above the town are worth traveling many long miles to see. Mrs. Beck will always remember Cuzco as the place where she obeyed the demand of a devout barefooted Indian who sternly requested her to doff her hat, in the manner of all the men on the sidewalk, when the procession carrying the Holy Image passed on its way to church. The women of that country go to church bareheaded or wear only mantillas over their heads.

Lake Titicaca, 12,500 feet above sea level, bears on its bosom several steam-driven vessels as well as the numerous balsas of the native Indians. On Saturdays and Sundays

there was quite a fleet of the latter craft tied up near the steamer which carries passengers and supplies to the Bolivian side of the lake, and the passing tourists had great opportunities to step across the wharf and snapshot the unwieldy looking canoes. Through the kindness of the Superintendent of Railways and Steamers I was furnished with a boat from a steamer in port to do my collecting, as the balsas were slow going, especially against the wind. The native hunters in these balsas, however, obtain many ducks, mud hens, and grebes by poling around the clumps and patches of tule close to shore, and we saw many birds of these species in the market, picked clean of feathers clear to the bill, which were being sold for about five cents gold each. One day I saw more than fifty in a pile ready for Sunday's market, most of them having been partly cooked to keep them from spoiling.

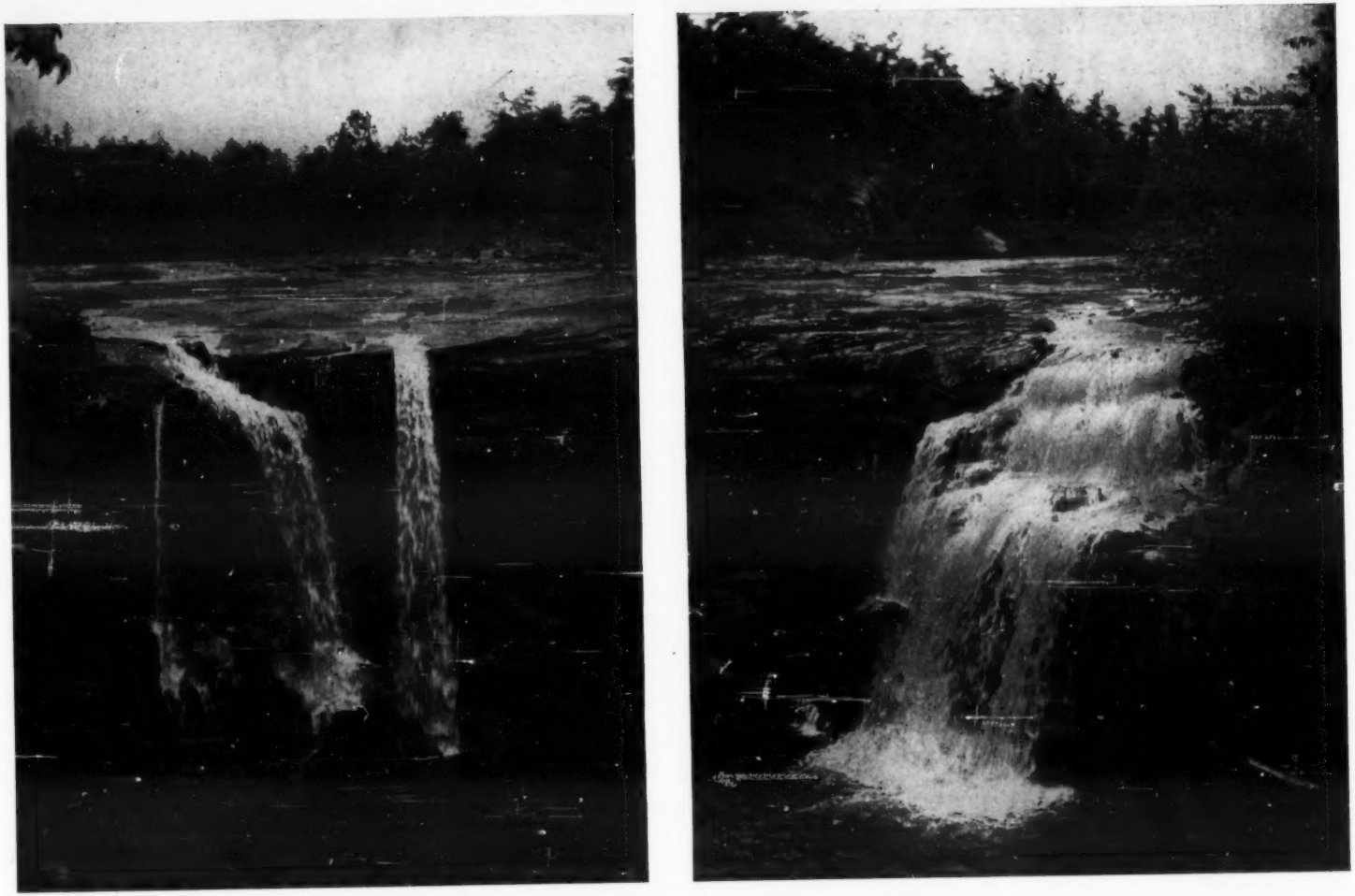
During our stay at Puno, which lies on the edge of Lake Titicaca, the Independence Day of Peru was celebrated, and the very excellent procession and cleverly arranged floats which were a part of the celebration would have been a credit to towns many times larger than this up-in-the-air community. We were particularly impressed with the fortitude of some of the lightly dressed children on the floats, as the procession halted in the cool evening air at various places around the plaza to allow the orators time for their declamations.

We rarely tired of strolling about the busy market place on Sunday mornings watching the llamas coming in with their varied loads of produce, and the haggling and bargaining of the poorer natives as they bought a cupful of grain or beans, it might be, or possibly a hat or a pair of sandals from some one of the dozens of venders squatted down in the open street with wares spread out in front of them.

At the end of a month we had collected the desired birds and, having packed them securely for shipment to New York, headed downward toward Mollendo. The traveling, crescent-shaped sand heaps which are on both sides of the railway for several miles in one desert section of this journey are the most likely-to-be-remembered sights to the traveler. Dozens of the sand dunes are seen, all of them traveling slowly with the wind, the particles of sand from the windward side blowing up over the pile to be buried on the lee side, later to reappear and go over the top again.

The Harvard Observatory, near the famous Mt. Misti, with its very hospitable and courteous staff of American observers will be remembered by all Americans who take the pleasant ride out to it from Arequipa. Arequipa, at more than 7500 feet elevation, is the trading center for a large mountain population. One may see herds of llamas, laden with dried mutton and other mountain products, traveling the same narrow streets on which the electric railway runs; and in the evening one may visit the ice cream parlor, where men are the principal customers, and buy the finest pastry to be found in all Peru. Leaving Arequipa in the morning, we arrived at Mollendo at noon and, after dining, were rowed to the steamer anchored some distance out from the rocky coast on which the town is perched. At dark the anchor was weighed and we started southward to begin our work in Chilean waters.

The very pleasant reception and kindly treatment we received from all the English-speaking people, whether Peruvians, English, or Americans, with whom we came in contact in Peru, will always remain among our most vivid recollections of that wonderful country.



LITTLE RIVER FALLS, LOOKOUT MOUNTAIN, ALABAMA

These two views of the Little River Falls were taken on August 30, 1911, looking upstream, the one at the left from the DeKalb County side, the other, showing the larger fall, on the Cherokee County side. On the rocks in midstream and in moist sand at the edges of the river bed are many rare plants that would be destroyed if a dam were built here

Some Vanishing Scenic Features of the Southeastern United States[1]

By ROLAND M. HARPER

Formerly Botanist on the Geological Surveys of Georgia, Alabama, and Florida

As civilization spreads over the face of the earth more and more of nature's handiwork is necessarily disfigured or destroyed. The primeval forests are cut down to make room for farms and settlements, or are used up faster than they grow for fuel and building material, or in some localities are killed by fire, smoke, or smelter fumes. Picturesque rock formations are converted into building stone or road material, or blasted away in the process of mining, and waterfalls and rapids are dammed up for power or navigation, or both. As progress is the prevailing ideal, the conversion of irreplaceable natural resources into wealth is almost universally looked upon as not only inevitable but highly commendable, especially by those who do not look very far ahead. And of course if no trees had ever been cut or rivers dammed or mines and quarries opened this country would have only a sparse population living mostly on fish and game, as the aborigines did, and much of the scenery that we now admire and enjoy would be "wasting its sweetness on the desert air."

The immediate economic effect of the destructive exploitation of natural scenery is usually to increase the wealth of the individuals or corporations responsible for it, and sometimes to enable persons living in the vicinity, or even at a considerable distance, to get some necessities and luxuries, such as lumber, farm produce, or electricity, a little cheaper for a time; but that, to a true lover of nature at least, hardly seems a sufficient reason for depriving all future generations of the opportunity to enjoy or study the features in question. Moreover, the ultimate effect is merely to allow an increase of population, for that seems to depend on economic opportunities as much as anything else, and the total population of the world or any part thereof tends to keep pace with the total wealth. (This principle of limitation of numbers by opportunities is still more obvious in the case of wild animals and plants.) It is human nature to take pride in rapid growth and large population figures for one's own city or country, but it has not been proved that the inhabitants of congested districts are any happier or freer or more efficient than those who live farther apart, and at all stages of the world's history there have been those who sincerely lamented the passing of the good old days, when people were not so crowded and there was more opportunity for the development of individuality.

Somewhere between the primitive condition of a "howling wilderness" and that of areas almost completely occupied by farms or buildings, like Iowa, the blue-grass region of Kentucky, Manhattan Island, Prince Edward Island, Flanders, and the lowlands of China and Japan, there should be a happy mean, with a certain minimum of natural scenery, say not less than one per cent of every county and five per cent of every state, left intact for the benefit of all who may wish to enjoy it now or hereafter. There is perhaps no purer pleasure than that derived from the contemplation of nature's masterpieces, and a world in which some of them are within easy reach of every one ought to be a happier world than one wholly dominated by commercialistic motives.

It is said that the appreciation of nature is a comparatively modern concept, which hardly existed anywhere a century or two ago; medieval travelers saw nothing but hideousness in alpine scenery, and in primeval forests they were in constant fear of wild beasts and unknown perils. But now

[1] All the illustrations are from photographs by the Author, except those of Tallulah Falls and Stone Mountain, for which he is indebted to Prof. S. W. McCallie, State Geologist of Georgia.

In the few months that have elapsed since this article was put in type the termination of the great war has altered some of the situations described, but it seemed better to publish it in its present form and ask readers to bear this circumstance in mind than to undertake extensive alterations at this time. Another recent development worthy of mention is the organization a few months ago at Waycross, Georgia, of an "Okefinokee Society," whose object is to preserve from destruction the great swamp described herein.

View near the southern end of the Everglades, looking south.—Note the calcareous incrustation on the saw-grass stubble. Photographed March 29, 1909

when a particularly charming bit of scenery that has been enjoyed by thousands and is capable of giving pleasure to millions more if let alone, is threatened with destruction by selfish interests, a vigorous protest is often made, and sometimes is effective. And although many people even yet seem about as indifferent to the beauties of nature as animals are, there is reason for believing that the number of appreciative ones is increasing in spite of the vast development of industrialism.

Most New Yorkers probably are familiar with the long-continued fight to save Niagara Falls from spoliation by power syndicates, and can easily recall how the Palisades of the Hudson were saved for the public about ten years ago, after quarrymen had already done considerable damage. In the West quite a number of scenic features on government land have been set aside in recent years as national forests, parks, or "monuments," and the public is being invited and even urged to go and enjoy them. In California a few years ago there was a prolonged fight—successful in the one case and not in the other—to save the groves of Big Trees from exploitation by lumbermen and the beautiful Hetch-Hetchy Valley from being flooded to form a reservoir.

In the East, where there is hardly any more federal government land, beautiful tracts have been reserved by the states, like the Adirondacks in New York, Mackinac Island in Michigan, and Starved Rock in Illinois, or donated to the public by private individuals, as in the case of a part of Mount Desert Island, Maine, and Letchworth Park, in Livingston and Wyoming Counties, New York. And even in such a supposedly mercenary city as New York about ten per cent of the land area, some of it practically virgin forest, is reserved for park purposes, although it would be worth at least $100,000,000 now for business or residential purposes, and costs a large sum annually for maintenance.

Among places of scenic or scientific interest in the northeastern states which have been partly destroyed by the march of civilization are the Hempstead Plains of Long Island, some of the beaches of southern New Jersey, the Kankakee marshes of Indiana, the prairies of Illinois, and the Dalles or Dells of the Wisconsin River. The present article deals with a number of such places in the southeastern states, equally attractive or interesting but not so widely known, that are about to meet a similar fate, or have already been partly or wholly ruined. Some of them have been written about at considerable length in publications of wide circulation, while others are known chiefly to botanists, zoölogists, and persons living in the vicinity.[1]

Okefinokee Swamp, covering about seven hundred square miles in southeastern

[1] Descriptions of the Everglades have appeared in several encyclopædias, and notices of the Hempstead Plains, Okefinokee Swamp, and Stone Mountain, with references to some previous literature for each, can be found in the latest edition of the New International Encyclopædia (1914–16).

Georgia, partly wooded and partly open marsh or wet prairie, has been visited more by hunters than by sight-seers, but it has charms all its own for those who appreciate the wilderness. A fanciful account of it, based on Indian legends, was published as long ago as 1791 by William Bartram, but most of the literature relating to it is less than ten years old.[1]

The first serious disturbance of this primeval solitude had its inception in 1890, when a corporation organized for the purpose bought the greater part of the swamp from the state for 26½ cents an acre. A canal was soon dredged from the eastern margin to near the center, for the purpose of floating out the cypress timber to a sawmill on the edge of the swamp. It was planned to drain the area later, and convert it into farm land, which the promoters imagined would be very fertile. But the death of the president of the company in 1895 caused a cessation of operations before the swamp forests had been greatly disfigured, and the canal was put to good use in the next few years by hunters and occasional scientific explorers. After a dozen years or so had elapsed the successors of the original lumber company built a railroad from Waycross, the nearest city, into the northwestern part of the swamp, and began taking the timber out that way. This invasion seems to be still in progress, but perhaps it is not yet too late to make at least a part of the swamp a forest and game preserve, if sufficient interest can be aroused in such a project.

The Everglades is a vast saw-grass marsh, averaging about fifteen feet above sea level, and covering about five thousand square miles, in the southern part of Florida. It contains almost no timber or other useful vegetation, except clumps of bushes and small trees near its edges, and the saw grass which flourishes everywhere is a formidable

[1] A good description, with illustrations, published too late to be cited in the encyclopædia article, is that by Francis Harper in the *Brooklyn Museum Quarterly* for April, 1915.

Virgin forest of slash pine (*Pinus Elliottii*) with undergrowth of saw palmetto and other low shrubs, on Bugaboo Island in Okefinokee Swamp. Photographed August 7, 1902

West side of Paradise Key, or Royal Palm Hammock, showing the royal palms towering above the other trees. Photographed March 28, 1909

obstacle to navigation in the wet season as well as to walking in the dry season. Previous to 1890 there was no railroad anywhere near it, and the area was a *terra incognita* to all but the Seminole Indians who dwelt on its edges and to a few adventurous hunters and explorers who had penetrated the marsh for short distances. The extension of the Florida East Coast Railway to Miami in 1896 (and later to the Keys) made the Everglades much more accessible, and brought increasing numbers of sportsmen, tourists, nature lovers, and speculators; and since about 1905 the output of literature about it, both scientific and popular, has been considerable.[1]

Even before the railroad came near this had been looked upon as a potential farm area, on account of its mild climate and supposedly rich muck soil, and after many preliminary investigations and discussions, and a few heated political campaigns, the state began in 1906 the dredging of a series of canals to connect Lake Okeechobee, at the north end of the 'Glades, with the coast, and thus ultimately to drain the marsh. One canal from the lake to New River back of Fort Lauderdale was cut through a few years later, and has been used ever since, except in the driest seasons, by launches and other small craft. Considerable work has been done on other canals, and the water has been lowered a little, enough to allow some agricultural developments and real estate booms on the northern and eastern edges. At the same time a number of lawsuits and scandals have resulted from the attempts of enterprising speculators to sell land in the middle of the 'Glades (that cannot be drained for many years, if at all) at fancy prices to gullible persons living hundreds of miles away.

Chase Prairie, near the center of Okefinokee Swamp, on August 7, 1902

[1] Some of the best popular descriptions of the Everglades are in books and magazine articles by A. W. Dimock. An eloquent plea for the Seminoles has been made by Mrs. Minnie Moore Willson in her book about them, published in 1896 and later editions.

Muck land is not as inexhaustibly fertile as it appears to the uninitiated, however, and after the first few years needs to be fertilized heavily to produce crops; and the present war situation has made the supply of some fertilizing materials very uncertain, and thus tends to delay the exploitation of the Everglades, which would be a large undertaking at best. To drain this vast marsh would not only destroy a scenic feature that has no counterpart anywhere else in the world, but would also nearly exterminate countless birds and other interesting wild creatures, as well as the Seminole Indians, a formerly warlike but now very peaceful tribe. But the Indians have no status either as citizens or wards of the nation, and get no more consideration from the average Everglades promoter than the birds and alligators do.[1]

Royal Palm Hammock, or Paradise Key,

[1] So much has been written in recent years about the supposed advantages of draining swamps and marshes that some readers may be interested in the arguments on the other side of the question in the *Popular Science Monthly* 29:282–283. June, 1886; 73:85–91. July, 1908; *Science* II. 28:525. Oct. 16, 1908; and *Literary Digest* 67:890. Dec. 12, 1908.

The clumps of cypress trees and shrubbery dotting the marsh are known locally as "houses," probably from the fact that hunters sometimes camp in them

is a sort of island about half a mile in diameter, at the extreme south end of the Everglades, in Dade County, Florida. It is covered with a dense tropical forest, and is one of the few places in the United States where the royal palm (*Roystonea regia*) grows wild. There are at least one hundred of these graceful palms on the island, and the older ones tower above all the other vegetation, a picture worth going far to see. Several of the other trees, too, are rarely found outside of the tropics.

Until about ten years ago this beautiful hammock was inaccessible and almost unknown; but when the Florida East Coast Railway was extended to the Keys it passed within about ten miles of the spot, and settlers began to push out in that direction. As the soil of the island appeared to be quite fertile, some greedy vandals had thoughts of converting it into truck farms; but before such a scheme was made possible by the building of a road over the miles of jagged limestone and strips of marsh between there and the railroad, the Florida Federation of Women's Clubs became interested, and in 1915 secured the passage of a bill by the legislature placing the tract in their care.

This, however, was perhaps not an unmixed blessing, for the first step in making it more accessible was to build an automobile road right through the hammock, with Cape Sable as its contemplated destination. Then a custodian was installed and a clubhouse built to accommodate visitors, and the traffic has already brought in several weeds and of course will bring more and more, to say nothing of increasing the forest fire hazard. Worse still, it seems to be the in-

Looking up the gorge of Tallulah River shortly before the dam was built; Tempesta Falls in the foreground, Hawthorne's Pool just above, and the foot of L'Eau d'Or Falls beyond. Photographed by A. M. Turner in 1913

tention of some of the patronesses to "improve" the tract by cutting a number of trails through the forest and installing exotic orchids and other plants that nature never intended to grow there, thus further altering its natural appearance.[1]

Passing now to the subject of river scenery, it may be observed that on any stream the most picturesque places are usually its falls and rapids, and it is just these which suffer most from the encroachments of civilization, for every water-power development, or dam for slack-water navigation, disfigures or obliterates one of them. Some of the finest examples of such scenery have escaped until quite recently, however, either on account of the large amount of capital required to "develop" them, or their remoteness from cities, or possibly because public opinion was too adverse to their defacement.

One of the grandest manifestations of unharnessed power in the South was Tallulah Falls, on the headwaters of the Savannah River in the mountains of Georgia. The river there dashed through a narrow rocky gorge about five hundred feet deep, descending six hundred and sixty feet in three and a half miles. The village of Tallulah Falls, close by, was a favorite summer resort for people from the Piedmont region and coastal plain, and had hotel accommodations for about nine hundred persons. Up to 1911 the rugged scenery remained virtually as nature made it, but about that time the temptation to harness the falls proved irresistible, and one of the large hydroelectric power syndicates secured possession. Local nature lovers protested vehemently at the time, and sought to prevent the destruction by legal means, but the prospect of getting cheaper electricity for Atlanta (nearly one hundred miles away) seemed to outweigh all other considerations. The scenery of course has not been totally destroyed, but it is said that Tallulah Falls is much less popular as a summer resort than it was.

Squaw Shoals, on the Black Warrior River in Tuscaloosa County, Alabama, has always been comparatively inaccessible and unknown, but it was a beautiful place, and was of considerable botanical interest as being one of the few known localities for the rare spider lily, *Hymenocallis coronaria* (which grows only on rocky rapids from South Carolina to Alabama, and has already been exterminated from some rivers in the

[1] The most comprehensive description of Royal Palm Hammock, and one easily accessible to many readers of this JOURNAL, is by Dr. J. K. Small in the *Journal* of the New York Botanical Garden, for October, 1916. See also AMERICAN MUSEUM JOURNAL for February, 1918, p. 132.

Dam of the Georgia Railway and Power Company at Tallulah Falls, completed in 1914. Photographed by S. W. McCallie

same manner as here), the recently discovered umbelliferous plant *Harperella fluviatilis*, which seems to be confined to Alabama, and a few other species of more than ordinary interest.[1]

About six years ago there was begun the construction of a sixty-foot dam and lock at the foot of these shoals, as a part of a plan for extending navigable water up through the coal fields to Birmingham. The accompanying illustrations are from photographs taken in the summer of 1913, when the construction of the dam was well advanced, but the vegetation and scenery above it were still intact. The completion of the structure was celebrated on May 13, 1915, with much rejoicing and speech-making by the citizens of Tuscaloosa (who apparently have little to gain by it, however), and it is not recorded that there was any one present to mourn the passing of the natural scenery.

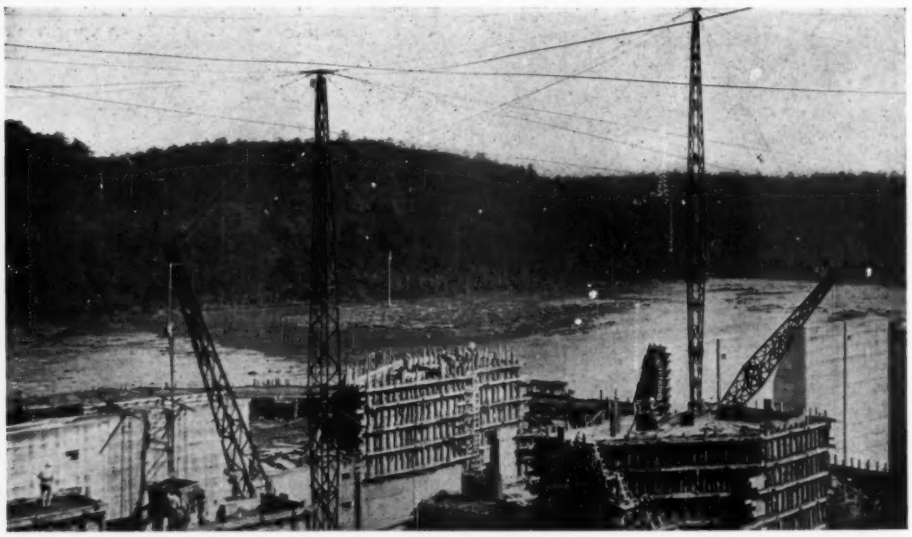
At about the same time a seventy-foot dam for electric power purposes was built on the Coosa River between Chilton and Coosa counties, Alabama, backing up the water to the vicinity of Talladega Springs, and submerging several square miles of land, partly forests and partly farms. This place had no particular reputation for scenery, being several miles from any railroad or settlement, but the ponding of the river flooded one of the few localities outside of the coastal plain for the small palm, *Sabal glabra*, and some splendid collecting ground for mussels, and is said to have almost ruined Talladega Springs as a resort.

The same power company that harnessed the Coosa River also has had designs on Little River Falls, a very picturesque spot on Lookout Mountain in Alabama, where some extremely interesting plants grow.[2] In August, 1911, numerous surveyors' stakes were in evidence there, but the contemplated destruction apparently has not yet been carried out. Perhaps it is not too late yet to save this place, which would not be worth much for power purposes, on account of the small size of the stream.

Mussel (commonly misspelled Muscle) Shoals, on the Tennessee River just above Florence, Alabama, where the river falls eighty-five feet in about fifteen miles, is an obstacle to navigation long ago circumvented by a canal, which did little damage to the scenery, flora, or fauna. But this spot has recently been selected as the site of the proposed government nitrate plant, which will mean a large water-power devel-

[1] For an account of the botanical features of this place see *Torreya*, September, 1914. The genus *Harperella*, discovered by the writer in Georgia in 1902, and now comprising three species, is one of the only two or three genera of flowering plants discovered in the eastern United States in the last three quarters of a century.

[2] Its botanical peculiarities have been discussed in *Torreya* 6:114. 1906; 14:154. 1914.



Lower part of Squaw Shoals, showing lock in process of construction in the foreground and beds of spider lilies (*Hymenocallis coronaria*) in the middle distance. Photographed June 4, 1913

opment there, to which local "boosters" will doubtless point with pride.

Many other recent water-power enterprises in the South could be cited, but it will suffice to mention only one more, which is a little different from the rest. Mammoth Spring, in Fulton County, Arkansas, about a quarter of a mile from the Missouri line, the largest spring in that part of the country, and perhaps the largest in the world outside of Florida, was dammed up at its very source some years ago to furnish power for a flour mill, and further encroachments have been contemplated which may destroy all semblance of its original appearance.

Lastly may be described two rock formations. One of the most interesting in the South, to a botanist at least, is a group of limestone grottoes near the Withlacoochee River in the southeastern corner of Citrus County, Florida, in latitude 28° 40′. It is not very conspicuous from a scenic standpoint, but it is noteworthy as a locality for several rare ferns, some of which are chiefly confined to the tropics, or are not known elsewhere north of the Everglades. Since 1881 this place has been visited by several well-known botanists, some of whom had very interesting and even exciting experiences there. When explored by the writer in March, 1915, it was still in its pristine glory, and there was no sign of any contemplated disturbance; but a few months later came the sad news that a limestone quarry was about to be opened on the spot. Some protests were made, but with little or no effect. The destruction is probably not complete yet, however, and it might still be possible to check it in some way.[1]

In some respects the most striking natural feature in all the southeastern states is Stone Mountain, in DeKalb County, Georgia, about sixteen miles from Atlanta by rail. It is a conspicuous landmark for miles around: a huge dome of granite rising about seven hundred feet above a comparatively level country, and covering about two square miles. The north side is precipitous for about half its height, and fantastically decorated with vertical stripes made by water trickling down, while the other sides slope more gently, and have a sparse growth of trees and shrubs in crevices and hollows. On

A near view of the spider lilies on Squaw Shoals, in water about a foot deep. Unlike nearly all other aquatic plants, the spider lily has a bulb, the function of which is doubtless to enable it to survive desiccation during prolonged periods of low water

[1] For a summary of all available information about this unique and more or less historic spot, see *American Fern Journal*, Sept., 1916.

and around the mountain are quite a number of plants not known outside of Middle Georgia, including among others the rare Georgia oak (*Quercus Georgiana*).

Although the sight of Stone Mountain must have amazed the earliest settlers, who came to that part of the state about 1820, it seems to have been unknown to scientists until near the middle of the century, when it was already quite a resort for sight-seers from near by and even had a rude observation tower on its summit. It is said that the village of Stone Mountain at its base (at first called New Gibraltar, doubtless on account of the resemblance of the mountain to the rock of Gibraltar) had three hundred inhabitants and four hotels in 1849. The Hon. Amelia M. Murray, an English lady of scientific proclivities, visited the mountain during a tour of the United States in May, 1855; but on mentioning it to northern scientists a few weeks later she found none who had heard of it.[1]

For many years, particularly since 1882, granite has been quarried from the northeastern base of Stone Mountain, out of sight of the village and railroad, but so enormous is its mass (estimated at about seven and a half billion cubic feet above the ground) that the stone taken out so far is scarcely missed. In 1900 there was little evidence that anyone had ever set foot on the mountain, notwithstanding its reputed ante-bellum popularity. But since then a boys' preparatory school has been established in the village of Stone Mountain, and a trolley line and automobile boulevard built out from Atlanta; and by 1913 a well-worn path from base to summit could be seen from a passing train, and two or three persons had lost their lives by slipping down the precipitous north side.

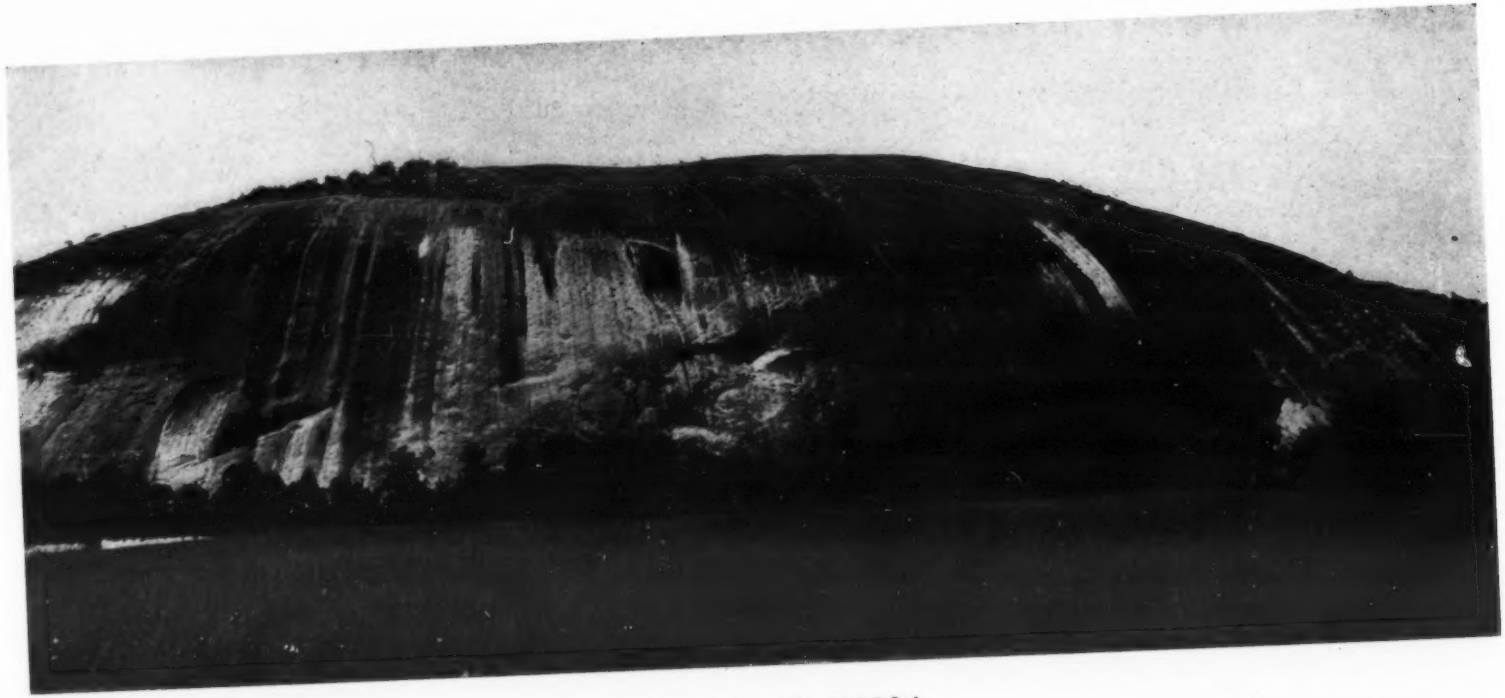
About three years ago plans were matured for disfiguring this massive monolith in a manner almost unprecedented, the object of which is not wholly mercenary, as in the cases previously described, but sentimental. Whether the idea originated with the artist or with the local Daughters of the Confederacy is not clear, but at any rate a well-known New York sculptor has been commissioned to carve on the smooth north face of the mountain, with an expenditure of several years' time and several million dollars, some gigantic figures representing scenes in the Civil War. Although the Georgians (of whom the writer was one during the best years of his youth) are to be commended for cherishing the memory of the Lost Cause, in this case they are taking a very extravagant way of showing it.[2]

As Stone Mountain has stood for countless centuries, and will for many more, it does not seem particularly appropriate to deface it irrevocably with nineteenth century scenes from other states, when some future century may well bring forth something equally worthy of commemoration and more directly connected with that locality, and perhaps may produce also a native sculptor to do the work. There are indeed some prominent people in Georgia opposed to the present project, but of course they cannot say much against it without having their sectional patriotism impugned. Outside of Georgia there does not seem to be much interest one way or the other, but there was a thoughtful note of protest in the *Nation* editorial referred to (which appeared first in the New York *Evening Post* of August 4). The present war situation bids fair to hinder the collection of the funds necessary for carrying out this bold project, all of which naturally could not be raised in advance; and perhaps the patriotic citizens who have been promoting it will find some less expensive way of expressing themselves. At the present writing it seems that considerable preliminary work has been done, but no actual carving; so there is still a chance for staying the proceedings. It seems a pity that the whole mountain has not been made a state park, to be protected forever from quarrymen, sculptors, and others who may seek to exploit it for the sake of wealth or notoriety.

In the foregoing pages the æsthetic reasons for preserving natural scenery have been put foremost, but another and still higher motive has been touched upon. An artificial park or flower garden might be just as pleasing to the eye, to most persons at least, as any natural landscape; but from

[1] See her very interesting book, *Letters from the United States, Cuba and Canada* (1857), pp. 312–313, 333. At least two botanists, T. C. Porter, of Pennsylvania, and H. W. Ravenel, of South Carolina, had been on Stone Mountain a few years before Miss Murray, and made known to science some of its peculiar plants.

[2] For additional details about this project, in magazines and weeklies of wide circulation, see *Bulletin of the Pan-American Union*, April, 1917; *World's Work*, Aug., 1917; *The Nation*, Aug. 9, 1917; *Literary Digest*, Aug. 18, 1917.



STONE MOUNTAIN, GEORGIA

This shows the precipitous north side of the mountain with a small patch of forest on the upper slopes. The lowest three hundred feet or so on this side are almost vertical, and it is on this face that the sculptor proposes to place his gigantic carvings, putting the workmen in cages suspended on steel cables and directing their operations from a distant point commanding a view of the whole. Photographed by Dr. T. L. Watson, about 1902

a scientific standpoint there is no comparison between them. Any sort of place can be beautified to the owner's (or the public's) taste by the expenditure of time and money, but when natural scenery is destroyed all the money in the world cannot restore it.

Every interference with nature diminishes the opportunities for studying the working of the laws of nature; and without a knowledge of such laws we do not get as much out of life as we should. Although a short-sighted utilitarian might claim that many natural laws have no possible economic application, no man can say just what the near future may bring forth, and it behooves those who have the rare gift of making correct generalizations from observed facts to embrace every possible opportunity to learn nature's ways. The loss of scientific opportunity through commercial exploitation is perhaps least noticeable in the case of the lifeless and motionless rock formations, which may be worth less for scientific than for scenic purposes. Dams on rivers are more to be deplored, for a river is a thing of life, so to speak, and a dam not only interferes with its normal regimen (making subsequent discharge measurements of little value, as has been pointed out in numerous government reports on stream gauging), but also drowns out the vegetation and fauna characteristic of swift water and not found in the quieter reaches, and restricts the migrations of fish.[1]

Forests are among the most easily destroyed of natural features, and their loss is most disastrous to science, for many types that occupied our most fertile soils have disappeared entirely, and can never be restored exactly by letting the land grow up in trees again, or even by re-planting the same species. Plant sociologists and ecologists could learn many valuable principles that are now unknown if they could select a number of tracts of virgin forest and study them without interference for several or many years in succession, counting and measuring all the trees every year or so, and calculating the percentage and rate of growth of each species. But any tract selected for such a purpose, unless preserved from private exploitation, is likely at any time to be damaged by woodcutters in such a way as to spoil the experiment.

Let us hope that in the not distant future public sentiment will be sufficiently enlightened to oppose the common *laissez-faire* policy of allowing a few individuals for their temporary advantage to deprive all future generations of part of their share of nature's wonders. Fortunately we already have several organizations working toward this end in one way or another. The American Scenic and Historic Preservation Society, incorporated in New York in 1895, was one of the pioneers in this movement, and has been instrumental in preserving Letchworth Park and the Palisades, as well as many spots of historic rather than scientific interest. The Wild Flower Preservation Society, organized at the New York Botanical Garden in 1902,[2] is interested in particular species of plants rather than in vegetation in general, but the preservation of the one of course involves the other to a considerable extent. The Ecological Society of America, organized in 1916, has still more nearly the right point of view, and is now gathering data about places of ecological interest in the United States and Canada that ought to be preserved for scientific study, which data will probably be compiled and published in some form before long. The nation-wide conservation movement of the last ten years, although its object is economic rather than scientific, has doubtless awakened many persons to the realization that our natural resources are not an inexhaustible reservoir from which everyone who can may help himself without limit and without regard for his fellow men.

[1] For a comprehensive discussion of the influence of the new Keokuk dam on the fishes and mussels of the Mississippi River see a paper by Dr. R. E. Coker in Appendix 8 of the *Report of the U. S. Fish Commission* for 1913. The effect of the same dam on scenery and sport is described and illustrated by Orin Crooker in *Forest and Stream* for May, 1915. (The same number contains the first instalment of an interesting article on Okefinokee Swamp by Will H. Thompson, brother of the late Maurice Thompson.)

[2] See this JOURNAL for May, 1917, pp. 350–352.

Nature's Mobilization

By VICTOR E. SHELFORD

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NATURE is a remarkable mobilizer. Instead of all plants and animals reaching the adult stage at the same time, their time of maturity is distributed throughout the best growing season. Each plant matures at a time when it performs its duties of feeding the animals which must be nourished at just the time they require food. It produces seeds, which insure its own existence, but immediately afterward it often falls into insignificance and thus makes way for the plants which are to follow and in their turn for a brief period hold the center of the stage. The animals also of any area appear and disappear, as adults at least, in a similar manner.

To realize what this means one has only to imagine all the plants of a given meadow blossoming during a few days in midsummer, and all the animals (particularly insects and spiders) reaching the adult stage at the same time. Such a state of affairs would produce a grand carnage, an indescribable destruction of living things, a veritable cosmic chaos. Such few living things as were left after the terrific struggle for egg-laying places for instance, a few wrecked blossoms not used as food for the writhing insect hosts or pierced by the innumerable egg-laying individuals, these might appear another year as scattered survivors of the battle for existence, to feed the shattered wreckage of insect life.

We all realize that this picture may be overdrawn. Another aspect of the matter is of far-reaching significance, namely, the drain on the soil moisture. The crowding of plants alone would cause marked undesirable effects. Nature ordinarily avoids all this confusion—each unit takes its place in time, the food-producing unit just in time to provide for each great army of insects, spiders, birds, or rodents. At the same time the precious soil water supply is not overtaxed—there is no drastic "coal order."

The orderly sequence of nature's mobilization, the time of flowering of plants, the time of nesting of birds, the time at which each insect pest begins its depredations have long been matters of curiosity and observation. The fact that plants flower, fruits ripen, insects appear and disappear in succession one after the other throughout a growing season, needed no statement even to the savage huntsman. The usual succession of appearances are general guides to many operations of primitive agriculture.

Seasonal succession has long been scientifically investigated also. The renowned Swiss botanist, de Candolle, was an early investigator who laid the foundation in 1830 for much that is modern in the work. The analysis of the physiological causes of the usual seasonal mobilization draws on many of the laws of biology merely to formulate the outline, or even a portion, of a life history, as for instance, the answer to the question why apple worms pupate in the spring at a certain time and transform into moths which deposit eggs only on apple trees or their near relatives.

It has often been assumed that the "errors" in the seasonal mobilization of plants and animals in undisturbed nature are few and unimportant. Under agricultural conditions, they are more frequent, and are accompanied by disastrous results. In the late winter of 1907 it was very warm in the southern part of the wheat belt of the United States. The grain aphis or green-bug which reproduces at temperatures at or near freezing and up to 100° F. (a very unusual characteristic for a land animal), multiplied without interruption during a long period, while the more orthodox lady-bugs, aphis lions, and parasitic insects which feed upon them were unable to do so. Low spring temperatures further retarded the development of these latter forms. It was a mobilization of the green-bugs without a mobilization of the enemies to check them. When the green-bug enemies arrived with the coming of warmer weather, green-bugs were so numerous that little impression was made toward reducing their numbers, and the southwestern wheat crop was ruined. There was heavy trading in the Chicago board of trade; advance in prices of grain echoed over the entire country and perhaps the world. What a disaster such an outbreak could have brought to the Allied cause, all due to a little unusual weather!

The writer recalls a visit from a member of the board of trade who, when crossing the plains sixteen years before, had seen myriads of grasshoppers, migratory locusts so called, which swarmed over fields and railroad track. He had these confused with the seventeen year "locusts" or cicadas and expected the condition to be repeated one year later with damage to the wheat crop. He offered half of his "killing" if a timely prediction could be made to raise prices after he had bought heavily. His chief inquiry was, How regular and certain are such appearances of pests? He had seen the effects of an irregularly large number of individuals and his question was exactly to the point.

Two views of the same stream in May and in August, showing the extreme conditions which have to be met by the plants and animals which are its annual residents. The seasonal rotation of adult animals corresponds with the climatic changes, so that each species normally reaches its adult stage during optimum conditions for its feeding and propagation. If all the various species of, say, spiders were to appear at the same time, great carnage would result with total destruction of spider food

Under what conditions does each species mobilize? When and why does time of mobilization vary from the usual time? Under what conditions does it take place? When is it slow and when is it rapid? Millions in food and money are often at stake on such questions as these.

The problem of the beginning of activity or of development is one that has attracted much attention of late on account of the importance of ability to predict the time when various insect pests will emerge from hibernation or will reach a stage of development at which it is necessary to spray trees if such treatment is to prove effective.

In this connection attention has been directed to the effect of various factors such as temperature, moisture, and light, on the development of organisms. Temperature has for many decades received an undue share of attention. A principle stated by de Candolle emphasizes the fact that there is a temperature below which development does not take place in plants, and various authors, including C. Hart Merriam, of Washington, have used this fact in mapping life zones. This temperature is now called the "threshold" of development. De Candolle also laid the foundation for the idea of the "sum of temperatures" above this minimum, necessary for a plant to complete a definite process, such as the ripening of seeds. The daily mean temperatures above the lowest limit of growth, expressed in degrees, are added for all the days, giving a large so-called total "degree-days" or sum of temperatures. If the temperature is higher the number of days is less, but the total "degree-days," according to de Candolle's theory, is the same.

The life histories of plants are so long that the theory could not be experimentally verified by botanists. It remained for Krogh, the careful Danish animal physiologist, to demonstrate the limitations of the theory after several other animal experimenters had paved the way but missed the

point. He studied the development of several animals including pupæ of the common meal worm which are commonly raised to feed caged canary birds, and he found that the "sum of temperatures" law holds for only a limited range of temperature.[1] Hence the law of "sum of temperatures" is only a rough guide in dealing with the conditions of our latitude, but still a valuable one when used with some corrections—which are still to be worked out by scientific investigators.

There are marked variations in rate of development brought about by conditions other than temperature. The temperature at which development begins, as well as the rate at which it proceeds, is modified by light, moisture, wind movement, and other causes. Meal worms will live for a long time in air from which all moisture has been removed and, at the same time, on food which contains no moisture, but they lose weight. I once knew a school-teacher who felt sorry for them for having to live in the ordinary air-dry meal in which she had them in the schoolroom, so she added a little water and killed them all. A moderate amount of moisture such as occurs in ordinary indoor air and in air-dry grain is just what they require for growth. In other words there is an optimum moisture.[2]

Food is of much importance to all kinds of animals.[3] With a minimum quantity of food or with an insufficient variety of foods young mammals may be maintained at the same weight without growth. White rats have been maintained at practically the same weight for long periods. They retain their power to grow long beyond the age at which growth normally ceases (335 days) and for periods equal to half the normal life of the species, which is a thousand days. In the case of dogs such treatment results in dwarfing due to the loss of power to grow on the part of the skeleton. Disproportionate growth occurs in underfed cattle. Similar results are to be expected in underfed children. Effects of war starvation on innumerable European children will probably be detectable in adults a few years hence, although careful measurement may be necessary to establish it.

One phenomenon which has been noted repeatedly in connection with studies of nature's seasonal mobilization, a matter of common observation, is the variation in numbers of individuals in different years. The length of life of individuals may have a pronounced effect on the population and succession of species on a given area. It has been stated that the great number of individuals in the plankton of the polar seas in summer is due to the longer life of the individual at low temperature. Unless the low temperature slows the different processes unequally this can hardly follow. For example, if a female green-bug normally lives a week and produces one thousand offspring, and then the temperature is lowered so as to prolong the life to three weeks, unless the different functions were unequally affected by the change, there would be at the end of the three weeks but a thousand, while at the normal rate there would have been a billion possible individuals. On the other hand, if the rate of reproduction remains the same and the length of life of the individual after the reproductive period is increased, the results of lower temperature would be very different. Actual observations along this line are few. In the case of the San José scale, however, it has long been shown that the number of offspring is greatest in the individuals breeding in the warmest weather.

There is, to be sure, much evidence that the tendency to pass the winter in a dormant condition is not very firmly established in some species and that under the stimulation of indoor temperatures such animals may be

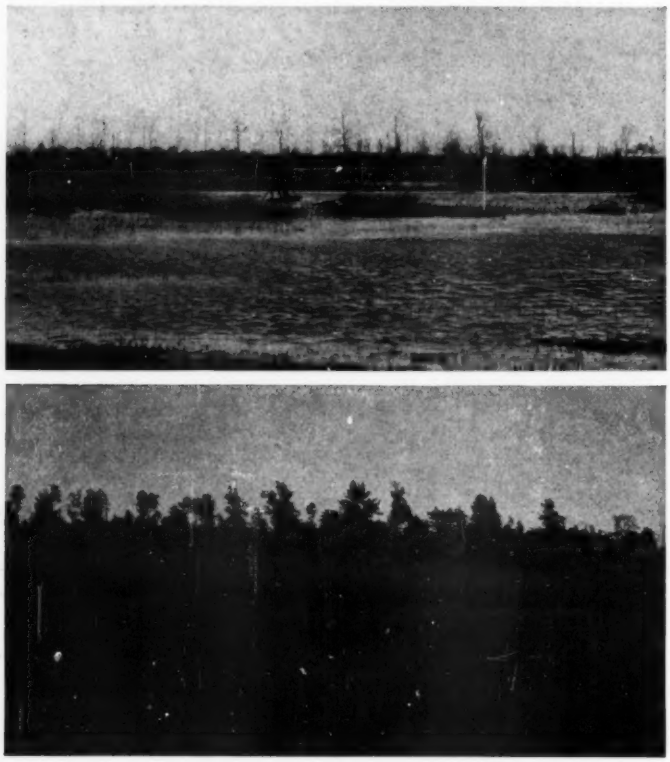
[1] That is, degrees above the temperature at which development does not take place, multiplied by the time unit, give a fixed sum only between 64° and 82° F., while development takes place between 55° and 110° F. At temperatures between 55° and 64° F., development is far too rapid and gives a smaller sum, while between 82° and 93° it is too slow and gives a larger sum. In the first case the sum of temperatures is too small, and in the second it is too large.

The temperatures shown as the "sum of temperature" *limits* for a common insect like the meal worm, would both be exceeded in an ordinary spring day as the temperature falls below 64° and rises above 84° F. One or both, the upper and lower limits, would be passed in nearly every day of the growing season for land plants and animals.

[2] This may even be different for different temperatures. Light, like moisture, may have important effects on the rate of development, but we know still less about it. It is known that absence of light is unfavorable to growth of insects which normally develop in light. Light is further known to stimulate the growth of some kinds of animals.

[3] The larvæ of the common museum pest (Dermestidæ) can not only be maintained at a definite weight by insufficient food, but may be reduced from half-grown to hatching size several times by repeated starving and feeding. This particular species is especially flexible, as all lower animals usually are to a less degree, and is peculiarly adjusted to its precarious life. Thus it seems that variations in food have effects similar to those produced by variations in temperature.

induced to reproduce nearly continuously, at least for a number of generations. Cessation of development or dormancy[1] in any given case is as much attributable to some factor falling below the threshold of development as to hereditary tendencies. The environment is extremely complex, and the number of factors already found which may cause cessation of development are numerous, including temperature, moisture, light, oxygen, evaporation, quantity of food, or absence of any one of many necessary food constituents.



A Chicago vacant lot as it appears in April and in August. A small section of this temporary pond does not ordinarily completely dry up, and, therefore, affords a breeding place for the tiger salamander. The seasonal succession in animal life is well illustrated in such a spot as this with its marked differences in temperature, vegetation, and moisture. For the order in which some of the animals appear in this lot see the following chart

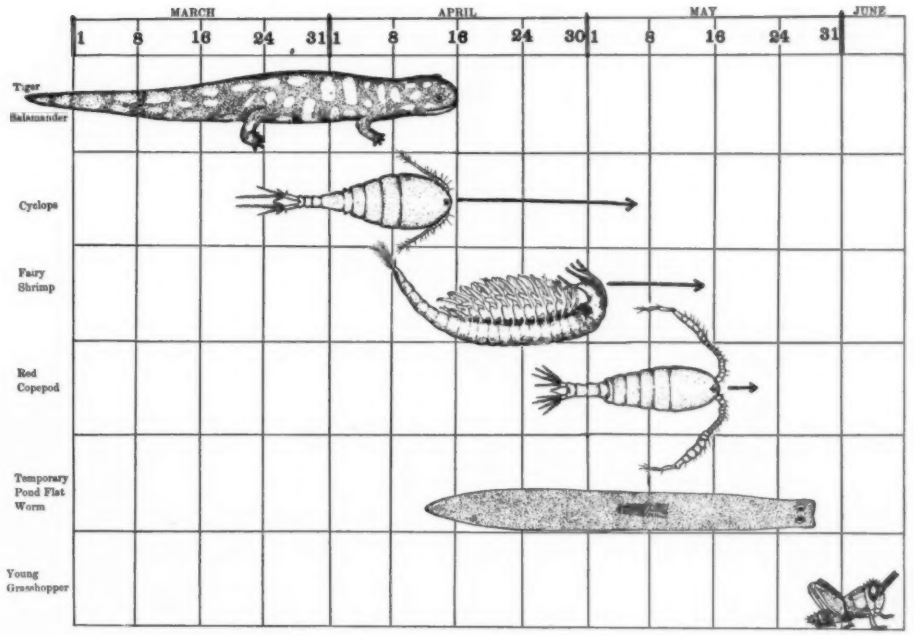
The reproductive bodies of the large gelatin-secreting bryozoan which grows to be as large as a man's head, are filled with air cells which cause them to float at the surface of the water. They are formed in the autumn but do not germinate until spring after they have been frozen.

The walking-stick drops its eggs from the tree trunks on to the ground in the autumn but they do not hatch until the following May at the earliest, or they may not hatch until one year from the following May if conditions are unfavorable. The cause of these delays or dormancies are often simple. The decay or rupture of an outer covering most commonly produces development.

The seasonal succession of animals is well illustrated on a Chicago vacant lot. The area chosen for study was covered with water in spring and with grass and weeds in summer. In a small part of it the water was permanent in all but the driest seasons. The parts which did not dry up afforded a place in which the larvæ of the tiger salamander could develop to maturity. The tiger salamander comes out of the soil as soon as the frost is gone, sometimes as early as the end of February or the first of March. The eggs are laid in March and early April and the adults burrow into the mud by the middle of April and are not seen again until the frost leaves the ground the following spring. The eggs hatch and such larvæ as find water which is permanent until the end of summer probably reach maturity. By that time the young are sometimes able to lead a terrestrial life.

The spring pond cyclops (*Cyclops viridis americanus*) occurs only in ponds or parts

[1] When all conditions are favorable for development some animals fail to develop. Their life histories appear to be adjusted to the annual rhythm of conditions. The state in which an animal is when development does not take place although conditions are favorable for it, is called dormancy.



Succession of five of the species—salamander, cyclops, fairy shrimp, red copepod, and flatworm—in a temporary pond on a vacant Chicago lot, from early March to June. The length of the animal's body (plus the arrow where present) indicates the dates between which adults of the given species may be found. The appearance of the grasshopper, a dry land form, is synchronous with the pond's drying up. Disorders in mobilization are not so likely to occur under such natural conditions as under the conditions to be found on agricultural land where great disorders frequently arise, especially among insect species which feed on the agricultural crops

of ponds which dry up in summer. The fairy shrimp (*Eubranchipus*) is a well-known example of an animal with eggs showing "dormancy." The local distribution of the fairy shrimp is likely to differ each spring. It is modified by the rainfall of the preceding seasons. When the rainfall of the preceding summer has been great, this and some other temporary pond species are found only in the smallest and highest (above ground water) ponds. Following dry seasons they are found in ponds which do not usually dry, but which were dry the preceding summer. Their eggs must be dried and frozen before they will hatch. Their distribution, following the seasons of different rainfall, suggests that some definite degree of drying must be attained to insure hatching, also that the eggs may be blown about by the wind. One autumn, about 1900, there was early freezing and cold weather followed by warm weather of a very springlike character in December. It was observed that the fairy shrimps hatched during this period of warm weather. Cold weather came on soon after and most of those that had hatched died before depositing eggs, and for several years thereafter the species was very scarce in the vicinity of Chicago. The fairy shrimp is found most commonly in grassy ponds, possibly because the forested ponds do not dry sufficiently in summer.

The minute red copepod of spring ponds appears to require a less definite amount of drying than the fairy shrimp, although it is found with it as a rule. It is found also where the fairy shrimp does not occur, and becomes adult a little later and disappears soon afterward.

The temporary pond planarian, or flatworm (as observed by Prof. C. M. Child[1]), shows very special adjustments to the peculiar seasonal rhythm of temporary ponds. When the animals first appear, soon after the ice melts, they are mostly only 2–3 mm. in length and commonly light in color. They grow rapidly and soon the dorsal surface becomes very deeply pigmented, so that they appear almost black. They are very active

[1] *Biological Bulletin*, Vol. XXV.

and move more rapidly than most fresh-water planarians. During this period they will eat meat and will gather in large numbers on pieces placed in the water. In about four weeks they attain a length of 12–15 mm., their movements gradually become slower, they cease to take food, become light gray in color, and the food-taking organs disappear.

Within a few days after these changes they begin to divide. As the worms creep about, the extreme posterior end adheres to the substratum and the rest of the animal pulls away and leaves it behind as a small fragment which becomes more or less spherical and within a few moments is covered with a slime which adheres to the underlying surface and hardens into a cyst. This process of division is repeated, often several times within a few moments, so that as the animal moves across a containing vessel it may leave behind it a series of such pieces. Under natural conditions the encysted pieces remain quiescent during the summer and the following winter; in early spring they emerge from the cysts as minute, very active worms which begin to feed. Complete drying under ordinary outdoor conditions is fatal to them; they survive among the moist vegetation of not-too-dry pond bottoms.

By the time the planarians have disappeared, grasshoppers and spiders have begun to appear. At the same time other land animals begin to move about the pond margin. The tarnished plant-bugs, which emerge from hibernation and lay eggs in early April, reach the adult stage in June and are to be found all summer. Adult sawflies emerge from pupæ that have passed the winter and their larvæ are on the young grasses in June. The buffalo tree hoppers hatch from eggs laid in the fall and are found in the adult stage throughout the rest of the summer. These examples illustrate some of the various peculiarities of life histories adjusted to the same climatic rhythm.

The collection and arrangement of the entire fauna of this Chicago vacant lot showed the same thing[1] as the animals just discussed, but proved much less satisfactory than was expected, owing to a lack of knowledge of life histories and an inability to identify young stages of insects. Disorders in seasonal mobilization on such a vacant lot are far fewer than the disorders among insects under agricultural conditions where nature's usual sequence of plants is replaced by corn or wheat.

Disorders of mobilization may occur under the stimulus of peculiar weather conditions, most easily in the closely set fields of agricultural conditions and results are such as we have noted for the "green-bug" in the wheat. This is only one type of disorder observable in agriculture. Others may result from failures to spray at the right time, which mean greatly decreased production, wormy apples, spotted pears, expensive bread, and wormy beans. As yet we know so little in this complicated field, that adequate prediction of insect pests can hardly be accomplished. But its importance is such that we can well afford to struggle through its complications into the light of a knowledge which will make reasonably accurate prediction of the rise of pests far surer than now. This means a careful experimental study of the conditions of such factors as temperature, moisture, and light, under which development can begin, and the rate at which it can continue.

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[1] Adult and juvenile spiders are among the best animals for such study. In the seasonal order, we start with the spring running spiders (*Pardosa modica*) in April, and we end the season with striped garden spiders (*Argiope trifasciata*), which appear as adults late in the season only.

Where our collections proved at all complete it was shown that the juvenile individuals follow the adults of the early spring species and both precede and follow the species which mature late in the season. Nearly all species are adjusted to the seasonal rhythm of the habitat in which they live. Thus *Dictyna sublata* appears as adult in May and June when eggs are laid, and juvenile forms characterize the late summer and autumn. The striped garden spider deposits eggs in October and passes the winter in the juvenile form. The large jumping spider (*Phidippus podagrosus*) reaches maturity in July, when eggs are deposited, and young occur in both fall and spring. These differences usually represent an innate adjustment of the life cycle to seasonal rhythm, not readily broken up. It is to be expected that *Dictyna* will deposit eggs to better advantage, and that the young hatch better in May than in November, which is the breeding time of the common funnel-web spider (*Agelena nævia*). It is further to be expected that the young stages of some spiders will not go on with development until cooled for a considerable period. Perhaps one of the most interesting questions concerning the whole matter of succession of spiders is to be found in the fact that all these spider life histories involve about the same periods of activity and rest. The rest period falls in different stages of the life history in different species. (For a detailed discussion of this matter, with table showing seasonal succession of adult spiders, see the Author's paper, "Physiological Problems in the Life-Histories of Animals, with Particular Reference to Their Seasonal Appearance," in *American Naturalist*, Vol. LII, pp. 129 to 154.)

Yachting in the Seven Seas

STRANGE SAILING CRAFT, EVOLVED IN DAYS OF PIRACY AND SLAVERY FASTER THAN THE SPEEDIEST YACHTS OF OUR MODERN BUILDERS

By F. A. G. PAPE, F.R.H.S., F.R.G.S.

Illustrations from original drawings by the Author

SINCE the dawn of time, man has gazed upon the mystic deep from shore and hilltop with an unconquerable longing to master the vastnesses beyond that elusive horizon which forever beckons like a Fata Morgana. There is but a single exception to this universal marine *Wanderlust* and that is found in some far southern parts where the dull-witted aborigines never have gone beyond the occasional construction of boats of reeds or bark with which to cross the smaller streams. This lack of enterprise might be attributed to scarcity of suitable building material, the forests of Oceania being preponderately of hard woods, were it not for the example set by the people of the North. The inhabitants of the tropics, on the other hand, were the first to overcome the difficulties of floating on the water, and from this to go on to the construction of vessels designed to ride swiftly over the waves in all sorts of weather. The northerners were handicapped by their inhospitable coasts and rigorous climate, so that all fine lines in boat building had to be sacrificed to the unwieldiness and roundness of form which make for safety.

The first purely floating structure, made of reeds or hide or similar handy substance, determined by the locality in which it occurred, was generally a one-man affair, propelled by paddling with the hands. This form of boat is best represented today by the Irish coble or the bladder boats of India and Mesopotamia, kindred rudimentary contrivances still being used in the enormous estuaries of Indian, Burmese, Siamese, and Indo-Chinese rivers. Boats of this character are made of a piece of soft wood about eight feet long, slightly bent upward and hollowed out to a certain degree. They serve not only to float upon the water, but they slide readily and without much effort over the flat oozy mud banks where to gain a footing would be impossible without sinking to the waist or farther.

Upon reflection it seems quite extraordinary that it took many generations before propulsion by paddle became common. It is not meant to convey the notion that odd pieces of wood or the like were not used in early times for this purpose, but the paddle as we know it today, of graceful line and light workman-like build, was slow to come into vogue, as was also the discovery that more than one would add greatly to the speed attainable. The use of a number of paddles involved the construction of an elongated oval boat instead of a round one, and this was not really feasible until man had learned the use of fire and sharp-edged tools, enabling him to fell and hollow out large trees. In this art of wood-shaping craft the Burmese excel all others. One need only contemplate the keel of one of their enormous but graceful boats to learn this fact. It requires skill of the very highest sort to take a tree trunk, often more than seventy feet in length, trim it, and fashion it into a thing of beautiful outline, with a proper "sheer" to it, the bow and stern rising proportionately above the "waist," while the center itself is artificially pressed and flattened out to accommodate the broad-bilge frame timbers which go to make the stability and carrying capacity of every well-constructed vessel. The full-powered paddle capacity at its maximum of course could be evolved only in localities where suitable timber of great bulk and straight growth could be obtained, as on the Pacific slope of North America, in some of the larger islands of the Pacific, in certain parts of South America, and along the larger rivers of Africa. We find the oar brought to greatest perfection in the northern part of the Old World, in the viking ships, the galleys of the Mediterranean, and the great clumsy craft of the Middle Kingdom.

An immense stride forward in ocean intercommunication was made when man first learned to utilize the wind as a means of propulsion. The deterrent factor, it seems, was not so much the lack of knowledge of the wind's power—for that must have been universally evident at an early date—as of the proper means by which to apply and control it. A tricky and uncertain wind volume is

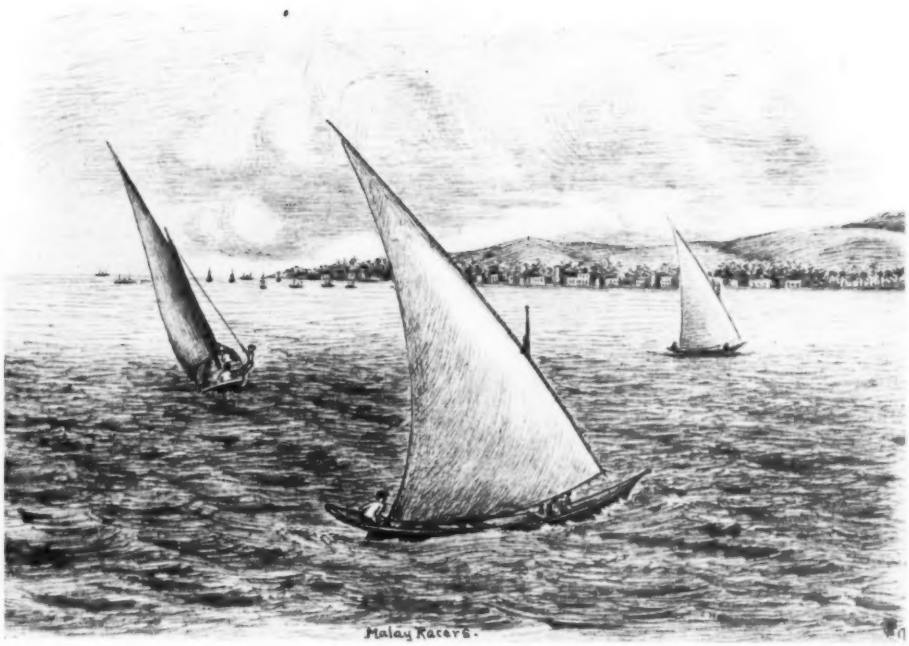
a bad master even now. A proper study of the wind element has not been completed today, when, owing to modern methods of propulsion by steam and electricity, wind power has been virtually discarded. But man still indulges, fortunately, in that most fascinating of all sports, yachting, which will ever hold its own among prime pastimes. It is the poetry of motion, calling at the same time for endurance, tenacity, and pluck of the highest sort. There is hardly an emotion in the human breast approaching the thrill which the evolutions of a well-found sailing craft can produce in the intrepid soul in tune with nature in its restless mood at sea.

It may be assumed with perfect justification that the tropics furnished the first instances of the application of sails to ships. In the warm latitudes we find almost universally a long season of balmy winds, which only at rare intervals assume the force of gales. It is true that the most violent atmospheric disturbances are within the torrid zones, but these occurrences are confined to certain seasons of the year, and seafarers almost always can guard against them. For that reason the craft of those latitudes are mostly of frail construction and made in such fashion that they can be removed readily from the water, out of harm's way. It is a lamentable fact that speed seems first of all to have been sought for felonious purposes. In war, in piracy, in slavery, speed soon became the decisive factor. Whoever possessed the speediest vessel for pursuing an enemy or eluding superior forces was soon recognized as having mastery on the sea.

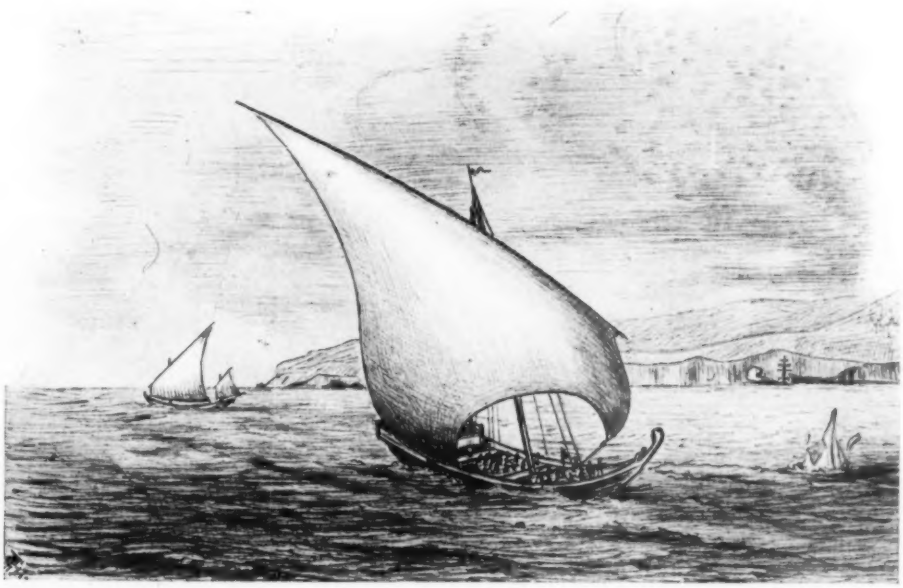
As a matter of fact, certain types of sailing craft used in the Indian Ocean today are, under given conditions, faster and more easily handled than the speediest yachts which our best builders put in the water. The smaller type of Arab "dhow," called usually "jahassy," is remarkable for its speed before the wind or with the wind over the quarter. This vessel is from thirty-five to fifty feet long. It has a very fine entrance, without much of a keel, and the stern is full and usually square. The jahassy sits low in the water, and the single mast, with a big rake forward, is stepped well ahead of the waistline. The sail is hoisted on an immensely long yard. The standing part of the halyards is taken quite aft, where the lower triple block is fastened also to the afterthwart. The mast is stayed by two shrouds on each side, which can be unhooked when the vessel goes in stays. The lateen-shaped sail, if well cut and made, can be trimmed up to about five points off the wind. In the slavery days, the squadron of jahassys which patrolled the East Coast and the Gulf had many a tale to tell of their speed and agility in escaping from justice. Nowadays these vessels follow the useful avocation of tenders to the big ocean liners, bringing small lots of produce from out of the innumerable estuaries and creeks of the coast where a steamer cannot well enter. A case in point within the knowledge of the writer was the pitting of a fine centerboard sloop of European build against these native racers on the Zanzibar littoral. In hard windward work the sloop could leave the jahassys out of sight in a couple of hours, but as soon as they got a fair slant they would beat the sloop hand over hand.

It seems that the Indo-Arab sea rovers, who very early penetrated as far east as the Moluccas, left their sailing skill as a legacy to the regions they visited, for we find that the craft in use there today are built along much the same lines as the Arabian ships. The prows, or prahus, of the Malays and Alfuros are similar in shape to those in the western part of the Indian Ocean, with a high poop and a low finely modeled bow. The construction, however, is not quite as solid and staunch as in the latter. A lot of makeshift matting, bamboo, and other contrivances fulfill the local requirements. The poop and the stem are often carved and ornamented most elaborately, as are also the high rudder heads and tiller poles. These swift Moluccan sailboats played their most prominent rôle when big, clumsy, square-rigged vessels from Europe traversed these waters laden with the riches of the far East. Old records contain many a thrilling tale of these elusive wasps of the sea tackling well-armed and well-manned merchantmen and not seldom overcoming by sheer numbers all resistance to their fierce assault. And this peril from sea raiders kept up well into our own days in spite of the vigilant naval patrol of the nations.

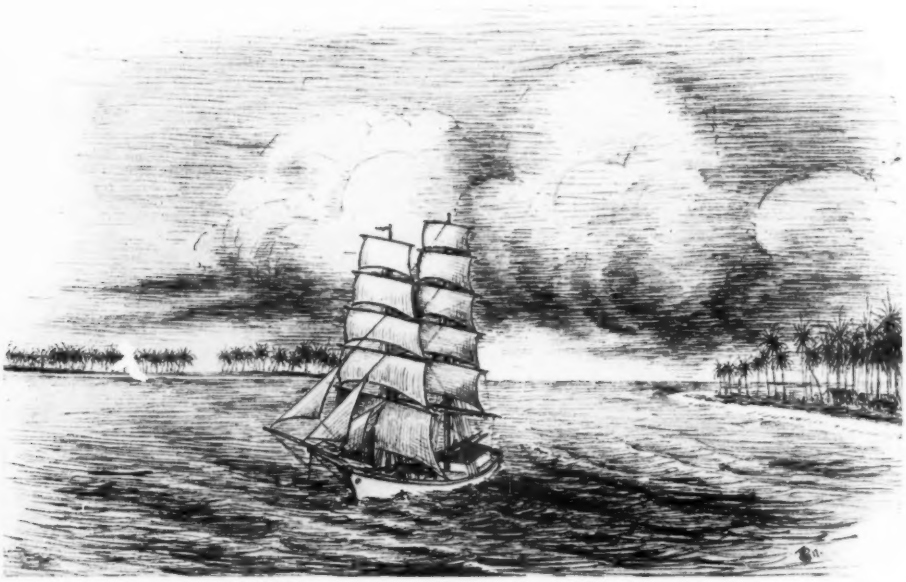
In the Straits of Malacca and adjacent regions the Malays have evolved a racing craft which is indeed like unto the wind itself. It is a vessel of very moderate size, often not much more than a canoe, but seaworthy withal, and met with on big open



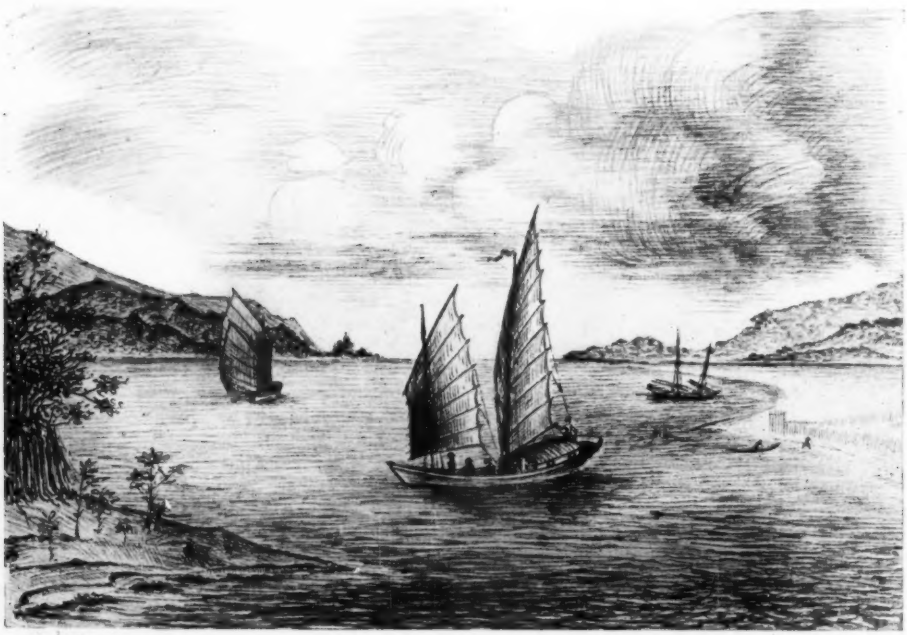
Often not larger than a canoe, Malay racers are found on big open stretches in the Straits of Malacca and adjacent regions, where on a breezy day they may be seen speeding across the blue waters like a flock of white gulls



Remarkable for its speed before the wind is the "jahassy," a small type of Arab dhow. On account of its agility in escaping when pursued, this type of vessel earned an unenviable reputation in slavery days. In olden times the large single sail was woven of palm-leaf matting



In a latitude where flat calms are suddenly followed by fierce squalls, many sails are a distinct advantage, being quickly furled as a storm approaches and soon spread aloft when it is over. The "country wallah," constructed by the natives of Malabar and Coromandel, as well as by the islanders of the Maldive and Laccadive groups, appears to be smothered in a cloud of canvas



Another type of speedy vessel known as the "hleh" meets the exigencies of wind and tide to a remarkable degree in the Burmese waters of the Mergui Archipelago. The keel is a tree trunk artificially widened, and the Chinese form of sail having bamboo slats across at intervals of eighteen inches or so is used. The "hleh" has two and sometimes three masts, and a cabin is built in the after part

stretches of water. The mast is nearly perpendicular and stepped in about the first third of the boat. The tack of the high-pointed lateen sail is fastened in the bow, and the sheet reaches well aft. When the wind is abeam, one of the crew seizes a rope pendent from the mast top. Swinging himself outward, he stands on the weather gunwale, thus preventing the boat from careening too far. On a brisk breezy day it is one of the prettiest sights to watch a fleet of these Malay racers speed across the blue waters like a flock of white gulls.

Farther up the peninsula, in the Burmese waters of the Mergui Archipelago, the lusty coast folk have produced another type of speedy vessel. Its keel is a tree trunk, widened out artificially. The Burmese have borrowed the Chinese style of sail with bamboo slats across at intervals of eighteen inches or so. While this is very convenient for reducing sail, it produces too flat a surface for getting the maximum of power from the wind. These vessels have always two and sometimes three masts. The mainmast is stepped perpendicularly; the foremast tends to rake over the bow. When there is a third or jigger mast, this conforms to the set of the mainmast. Out in the open these "hlehs" attain a wonderful degree of speed. When going through one of the countless channels between the islands and estuaries, where the high-growing mangroves often intercept the wind, these vessels are propelled by means of "sweeps" or long oars, the crew standing on the deck to manipulate them, somewhat after the manner of Venetian gondoliers. The "hleh" has a cabin built into the afterpart. It resembles the high poops we used to see in pictures of galleons or similar mediæval vessels.

The natives of lower Malabar and Coromandel, as well as the islanders of the Maldive and Laccadive groups, construct a swift vessel in imitation of European style with more or less graceful models. They have also adopted the rig in vogue in northern latitudes. At first sight this appears to be a dubious advantage, but when investigated it seems reasonable enough. For the European sail fashion allows of manifold division. These boats, which are locally called "country wallahs," are mostly brig-rigged with a tower of masts and canvas. One can often see sky sails on these diminutive vessels. All this canvas looks ridiculous, but it is best suited to conditions in those latitudes, where there is "either a feast or a famine" with the wind. Protracted periods of flat calms when there is scarcely a breath are suddenly followed by fierce outbursts of squalls. It can readily be seen that in the doldrums the enormous spread of canvas is of distinct necessity. The "country wallah" appears to be smothered in a cloud of it. The lower sails may be hanging flat but in the upper air the wind current fills the topgallant sails, royals, and skysails, and the old hooker sneaks along at quite a respectable gait. On the other hand, the appearance of the sky invariably gives due warning of the coming squall. When the "woolpacks," or heavy hanging cloud masses with a dark fringe underneath, begin to gather and to rise to the zenith, then it is time for all good and well-conducted "country wallahs" to gather in their "linen." In a jiffy the crew swarm aloft and furl the multitude of sails, often no bigger than a blanket, and the vessel is ready to take the fury of the squall, end on as a rule. It does not last long, and when it is over it is but a few minutes before all the canvas is aloft again. Sometimes one sees a whole fleet of these vessels making for a certain point. From afar it looks exactly like a squadron of ancient war ships or a convoy of "John Company's" famous Indiamen. The disparity in size disappears. The illusion is complete. The true lover of the sea conjures up vistas of doughty deeds of old. Here are "full ten sail of the line, and a score frigates" conning the offing for Dupleix's intrepid rovers. The mastery of the East is at stake.

Least of all in size, but not in interest, are the quaint boats made of palm-leaf ribs sewed together with coir fiber, used by a moribund race of people, the Selungs, in the archipelagoes bordering the eastern fringe of the Bay of Bengal. The Selungs live in these boats almost entirely. They subsist chiefly on sea food, which is probably the reason they are afflicted with leprosy. By means of very long bamboo ladders they endeavor to procure *salangan* or edible bird's-nests from the precipitous sides of the immense outcrops of granite, which are nearly one thousand feet high and almost inaccessible. They also gather a few mother-of-pearl and green snail shells to trade for cloth and other necessities. These people are shunned by the Burmese and Malays, who look upon them with aversion.

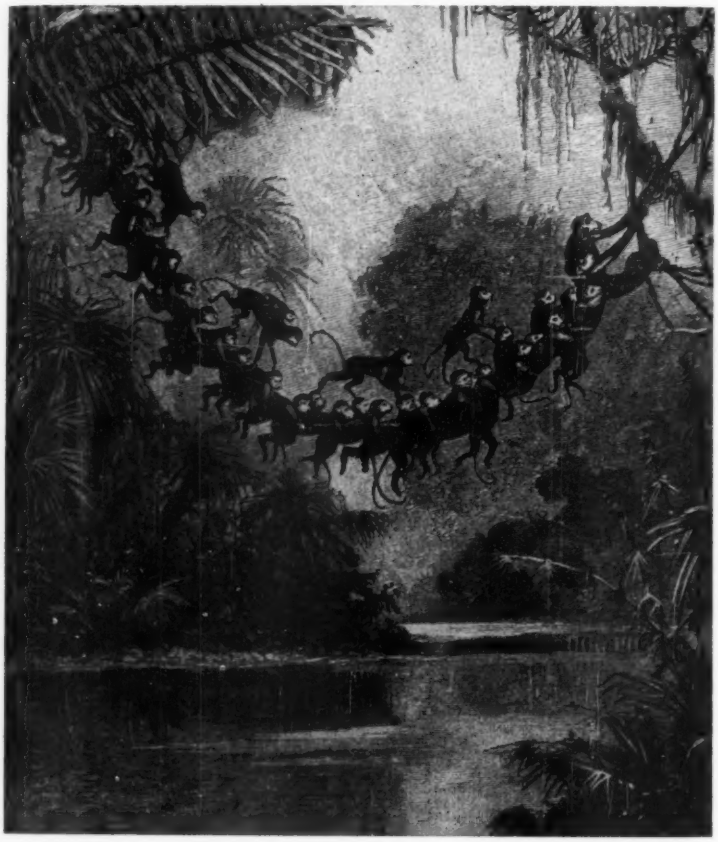
The Myth of the Monkey Chain

By E. W. GUDGER

Professor of Biology, State Normal College, Greensboro, North Carolina

THOSE who were so unfortunate as to study geography in the "prehistoric days" before Maury and Frye had revolutionized the teaching of that subject, will recall the wonderful picture and the equally wonderful account of how, in northern South America, monkeys by intertwining tails and legs made a living bridge across crocodile-infested streams.[1] This story had as its author the Jesuit priest Padre José de Acosta, whose book[2] was published in an English translation at London in 1604, the original edition, in Latin, having been issued at Salamanca in 1589. Acosta's account (page 315, English translation) reads as follows:

"Going from *Nombre de Dios* to *Panama*, I did see in *Capira* one of these monkies leape from one tree to an other, which was on the other side of a river, making me much to wonder. They leape where they list, winding their tailes about a braunch to shake it: and when they will leape further than they can at once, they use a pretty devise, tying themselves by the tailes one of another, and by this meanes make as it were



In days not so long gone by our schoolboys were regaled in their South American geography lessons by illustrations of a monkey bridge such as is shown in this cut which is taken from Holmes's *Fourth Reader* (1897). The myth of the way monkeys crossed alligator-infested streams started with the report of a Spanish explorer in the sixteenth century. Clinging to one another's tails so as to form a long chain it was said they would swing pendulum fashion until the end "athlete" could grasp a tree on the other side of the stream, after which all the mothers and babies would scamper across on the heads and backs of their accommodating relatives. Needless to say, this feat presupposes an amount of intelligence in the monkey family that it has never been known otherwise to exhibit, while aside from that, it is palpably impossible because nowhere in a tropical jungle could space be found in which to swing such a long chain as the story requires. The famous naturalist, Humboldt, was the first to deny the myth (1814), but it continued to live in schoolbooks and in the tales of travelers for many years

[1] Such a figure forms part of the headpiece to South America, on page 58 of Mitchell's *New Primary Geography*, published in Philadelphia in 1878.

[2] Acosta, Joseph, *Naturall and Morall Historie of the East and West Indies*. Translated by E. G[rimston], London, 1604.

a chaine of many: then doe they launch themselves forth, and the first, holpen by the force of the rest, takes holde where hee list, and so hangs to a bough, and so helpes all the rest, till they be gotten up."

This tale has been handed down from one author to another. And there is little doubt that a careful search through the literature pertaining to northern South America, during the one hundred and fifty years following the publication of Acosta's book and its various translations into Italian, French, Dutch, German, and English, would show many repetitions and variations of the marvelous story.

Lionel Wafer, a companion of the celebrated navigator, Captain Dampier, says[1] that in crossing the isthmus they saw and killed a number of monkeys, and continues:

"They are a very waggish kind of Monkey, and plaid a thousand antick Tricks as we march'd at any time through the Woods, skipping from Bough to Bough, with the young ones hanging at the old ones Back, making Faces at us. . . . To pass from top to top of high Trees, whose Branches are a little too far asunder for their Leaping, they will sometimes hang down by one anothers Tails in a Chain; and swinging in that manner, the lowermost catches hold of a Bough of the other Tree, and draws up the rest of them."

Neither Acosta nor Wafer gives any figure to illustrate his account, but this is supplied us by another South American traveler, Ulloa. In 1735, Jorge Juan y Santacilia and Antonio de Ulloa were sent out as the Spanish members of a joint commission to measure an arc of the earth's meridian on the plateau of Ecuador. Coming by ship from Europe to Porto Bello, they crossed over the Isthmus of Panama to the Pacific side, where they took ship for Guayaquil, whence they made their way overland to Quito.[2] As Ulloa and his companion made the trip across the isthmus, they described as though they saw that which Acosta thought he beheld one hundred and seventy-five years before. At any rate Ulloa says:[3]

"The different species of monkeys, skipping in troops from tree to tree, hanging from the branches and in other places six, eight, or more, of them linked together, in order to pass a river, and the dams with their young on their shoulders, throwing themselves into odd postures, making a thousand grimaces, will, perhaps, appear fictitious to those who have not actually seen it."

Antonio de Ulloa, who crossed the Isthmus of Panama in 1735, was the first explorer to give a picture showing monkeys accomplishing the feat of bridging a stream. He remarks that the tale sounds fictitious to one who has not seen it, but whether he himself saw it or not, he does not say

Ulloa does not explicitly say that he saw this "fictitious" sight, but the inference is

[1] Page 108 of *A New Voyage and Description of the Isthmus of America*, London, 1699.

[2] The two men divided the labor of writing up their expedition. The scientific work was described by Jorge Juan y Santacilia and published at Madrid in 1748. The historical and narrative account of the voyage was written by Antonio de Ulloa, although singular to say, the original edition as well as the English translation (1760) bears the name of both men. Abbreviated somewhat as to the title, it is as follows: *Relacion Historica del Viage a la America Meridional . . . por Don Jorge Juan y Don Antonio de Ulloa*. Madrid, 1748. This obscure title has led to the conclusion that the first author was Jorge Juan Ulloa, whereas his name, as I have been informed by the Library of Congress, is y Santacilia. The book, however, is commonly referred to under the heading "Ulloa, 1748," he being the real author.

[3] George Juan [y Santacilia] and Antonio de Ulloa. *A Voyage to South America . . . together with The Natural . . . History*. . . . 2 vols. London, 1760; vol. I, p. 109.

that he did, especially as he gives a picture of it.

After this the marvelous tale seems to have gone unchallenged for nearly one hundred years, or until about 1814, when Humboldt gave the weight of his great name in controversion.[1] Speaking of howling monkeys, he writes:

"Whenever the branches of neighbouring trees do not touch each other, the male who leads the party, suspends himself by the callous and prehensile part of his tail; and, letting fall the rest of his body, swings himself till in one of his oscillations he reaches the neighboring branch. The whole file performs the same movements on the same spot. It is almost superfluous to add how dubious is the assertion of Ulloa, and so many otherwise well-informed travellers, according to whom, the *marimondos* [*Simia beelzebub*], the *araguatos*, and other monkeys with a prehensile tail, form a sort of chain, in order to reach the opposite side of a river. We had opportunities, during five years, of observing thousands of these animals; and for this very reason we place no confidence in statements possibly invented by the Europeans themselves, though repeated by the Indians of the Missions, as if they had been transmitted to them by their fathers [the Fathers?]. Man the most remote from civilization, enjoys the astonishment he excites in recounting the marvels of his country. He says he has seen what he imagines may have been seen by others. Every savage is a hunter, and the stories of hunters borrow from the imagination in proportion as the animals, of which they boast the artifices, are endowed with a high degree of intelligence. Hence arise the fictions of which foxes, monkeys, crows, and the condor of the Andes, have been the subjects in both hemispheres."

Apparently Humboldt did not know that this story originated with Acosta. There is doubt also whether Ulloa knew of his reverend predecessor. In any case neither of them refers to Padre Acosta.

The story is found repeated ten years after the publication of the Ross translation of Humboldt, and strange to say in this particular account are to be found the details of how the chain is made and how it works:[2]

"No less remarkable is their ingenious method of crossing torrents and other minor streams which they often encounter in their ceaseless perambulations through the forest. As among men, all cannot swim with equal facility, so it is also with monkeys; accordingly the leaders of the troop, generally the strongest of the party, climb to the spreading branches of some tree projecting over the stream; one of them then twists his tail firmly around a branch, and letting his body hang, seizes upon the tail of the nearest comrade, who in his turn performs the same operation with the next, and so on until a sort of chain or living pendulum is formed, which in obedience to the laws of equilibrium oscillates slowly but constantly from their combined efforts to reach the opposite bank. This finally achieved, the last monkey secures himself to the most convenient tree. The others of the chain, now disengaged from the tree at the opposite side of the stream, wade through the water, each helped by his neighbor assisted likewise by the current. Some are, however, occasionally drowned, the last one in the chain especially, which circumstance has probably given rise to the popular proverb, *el último moro siempre se ahoga*—the last monkey is sure to be drowned."

This account is very circumstantial and if one reads Paez's book and sees how accurate in the main are his natural history observations, one feels inclined to lend credence. Then, too, how natural is the proverb about the drowning of the last monkey. At first I was inclined to think this a slip, for why was not the end of the chain on the other side of the river after the crossing as high above the water as the originating end? A little thought, however, cleared up this point. The lowest monkey of the oscillating chain would lay hold of the first bush or tree or branch with which he would come in contact, and would complete the living bridge, but would be unable to climb any higher because of the great weight of the monkeys pulling on him. Hence when the monkey who originated the chain let go, he would fall into the water.

This is all very plausible, exceedingly so, but as one reads Paez's fascinating narrative, it is seen that our author loves to tell a good story. Moreover, one finds that he quotes Humboldt to demolish any fictions or clear up any matters of which he finds himself on the opposite side, thus showing that he was well acquainted with Humboldt's writings, but he carefully refrains from quoting him on the monkey chain.

A journey was made over this very region

[1] I quote from the *Personal Narrative of Travels to the Equinoctial Regions of America during the years* 1799-1804, by Alexander von Humboldt and Aimé Bonpland, translated and edited by Thomasina Ross, London, 1852.

[2] Page 261 of Don Ramon Paez' *Wild Scenes in South America; or, Life in the Llanos of Venezuela*, New York, 1862.

of northern South America in 1867–68[1] by two travelers, H. M. and P. V. N. Myers. They, too, saw hundreds of monkeys swing from tree to tree, and refer to "the oft-repeated story, familiar to every boy, and which often finds credence among so many, of monkeys crossing streams on aërial bridges constructed from their own bodies," but declare that these bridges exist only in fancy:

"In the course of our travels in the tropics, during which we saw multitudes of these creatures, our observations convinced us that there was no foundation for the truth of the tale of the bridge-building monkeys; and in this belief we were, moreover, further confirmed by the statement of natives, who testified to their having never witnessed such a novel performance."

The last account which has come to the attention of the writer is found in Holmes's *Fourth Reader*,[2] bearing date of publication of 1897, just twenty-one years ago. The series of Readers to which this book belongs was much in vogue two decades ago. The reading lessons, eighty-five in number, are made up of extracts from the writings of the foremost authors of America and Europe. The incident referred to is so very detailed and circumstantial that it is quoted *in extenso:*

A Living Bridge

"I was once sailing down the Amazon, and making short trips up the rivers that flow into it. One night we had ascended a little stream so far that the trees on the banks nearly met overhead, and our boat could go no farther. It was not prudent to go back in the dark. So we anchored in mid-stream.

The air was full of strange sounds, made by strange birds and insects, which kept me awake until just before dawn, when I fell asleep in my chair on deck.

Suddenly I felt a rough blow on my face, and became wide awake. I saw hanging from a tree, and swinging away into the gloom, something that looked like a huge black rope. The end of it had struck me. In a moment back it came, swinging this time behind the vessel.

The rope gave forth a chattering noise; it was alive. A moment more, and it was clear to me that here was a company of monkeys trying to cross the stream. The sight was so novel, the plan so daring, that at once I gave these queer bridge-makers my closest attention.

They were hanging from a tall palm-tree that leaned out over the water. Three or four of the strongest had grasped the branches of this palm with their hands, feet, and tails, and were holding on as if the fate of the monkey race depended on them.

Other monkeys had taken hold of these, and let themselves hang down as far as they could. Then others, and still others, until there was a line thirty feet long and three or four monkeys deep. The last monkey of all did not cling to those above him, but was so held by them as to leave his arms and legs free. He was the gymnast of the troop, and the hero of the present exploit.

The dangling line hung so near the trunk of the palm that the lowest had been able to push against it, and thus cause a little motion. Successive pushes had set the rope swinging toward the opposite side of the stream. It was on one of these swings, when the end of the rope had reached as far out as the middle of the stream, that I was struck in the face.

Little by little the breathing, clinging pendulum kept gaining. Pretty soon it swung out so far that the leader caught a branch of a tree on the opposite bank, when, lo! there was a bridge in mid-air! At once there rose from all the line a chattering that must have been monkey cheers.

As soon as the leader had made good his hold, two or three monkeys ran across to help him. This finished the bridge; so, without further ado, it was opened to the monkey public.

Then there came out of the palm-tree a noisy crowd of all ages. They ran across the bridge as best they could, some on all fours, some upright, some with young monkeys on their backs, and all waving their tails and briskly jabbering, as if they were shouting to those ahead, 'Make haste, or the bridge will break!'

A very old monkey was the last to go over. Perhaps his limbs were stiff. Perhaps he could not see very well. It was certain that he had lost the fearlessness of his youth, for he picked his way along so slowly and nervously, that I could not help laughing outright.

Hearing so unusual a noise, the monkeys who were clinging to the palm did not wait for him, but let go and swung over to the other side. The old fellow narrowly escaped a ducking.

Then followed a curious scene. No sooner had the bridge cleared the water, than the monkeys loosened their grip upon one another. In less time than it takes to tell the story, the bridge dropped to pieces, and—what never happens with a common bridge—the pieces betook themselves to the tops of the trees, and were soon out of hearing in the depths of the forest."

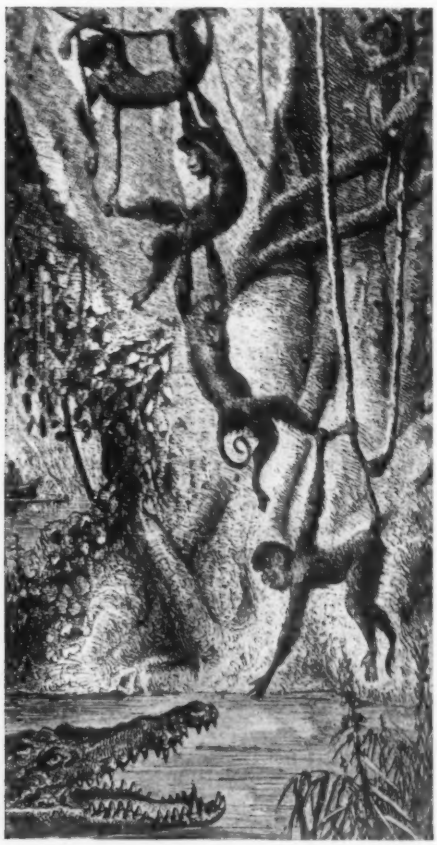
[1] The narrative appeared under the title *Life and Nature Under the Tropics* (New York, 1871).

[2] *A Fourth Reader*, by Prof. George F. Holmes (of the University of Virginia) and Prof. Frank A. Hall (Head master English High School, Cambridge, Mass.). New edition, copyrighted 1887, dated 1897.

To doubting Thomases this is staggering, because of the perfection of its detail, in which it agrees with Paez. The name signed to this short article is that of Charles Frederick Holder, a naturalist and man of high standing![1] I have personally made a careful search through all the works of Dr. Holder, in the hope that the original account might be found. The search proved futile, but it unexpectedly brought to light a confirmatory account. This latter, with a figure accompanying it, bears date of publication in New York just twelve years ago.[2]

Let us examine Holder's account more closely. First, it was not yet dawn, things could not be seen clearly; second, the stream was so small that the trees almost met overhead; third, the monkeys might easily have been hanging to limbs and making swinging leaps across the narrow stream; fourth, in these tropical countries the vegetation along the streams forms such a dense interwoven jungle that there is no space on the landward side for such a chain to swing back from the bank to get oscillation enough to carry it across the stream; and finally, this account attributes more collective intelligence to monkeys than they have ever been known to show.[3]

[1] Dr. Charles Frederick Holder was the writer of many books and a member of many distinguished scientific societies. He died in Pasadena, California, on October 11, 1915.



A possible source of the bridge myth lies in the interpretation which a not-over-accurate traveler might give to the sight of monkeys swinging in troops from the hanging vines so numerous in tropical forests. The above illustration, from Henri Mouhot's *Travels in the Central Parts of Indo-China (Siam), Cambodia, and Laos* (1864), purports to be drawn from a sketch by that naturalist showing the way in which Old World apes torment their greatest enemy, the imperturbable crocodile, by swinging about his head and tapping him now and again—until some one of the frolickers more foolhardy or less agile than the rest gets his paw caught in the trap and vanishes into the crocodilian interior. The truth of this report is open to doubt, and at any rate the drawing has received additions from the artist's imagination inasmuch as Old World apes do not have prehensile tails

[2] *Half Hours with Mammals.* Charles Frederick Holder. New York, 1907.

[3] This is said notwithstanding the fact that S. G. Goodrich in his *Illustrated Natural History of the Animal Kingdom* (Vol. I, page 103, New York, 1859) says: "This account [of the monkey chain] has been doubted by some naturalists, but we are told by Mrs. Loudon that a similar feat is often performed by these monkeys in the Menagerie of the Zoological Gardens at London." If this is true, then it is strange that, so far as the present writer knows, no published statement of such action has come from the eminent men who have for so long reported in the *Proceedings of the Zoölogical Society of London* the happenings in its Zoölogical Garden.

Now Mrs. Loudon before her marriage was Jane Webb, and as Jane Webb she was a very prolific writer of popular natural history books. The British Museum catalogue lists some dozen or more of these works, but unfortunately neither the library of the American Museum of Natural History nor the great New York Public Library possesses any of them, so I have not been able to run down this statement. However, another quotation from Goodrich casts discredit on his whole account.

On the same page, he quotes Dampier, the navigator, in detail as to the formation of the bridge on the "Isthmus of America." Now the standard edition of Dampier's *Voyages* is that of 1729, the sixth I believe, which has recently (1906) been published in fine form under the editorship of John Masefield. In this copy there is *no account whatever* of the monkey chain or of any activities of monkeys in that part dealing with Dampier's crossing of the Isthmus of Panama. Indeed the only place where their antics are referred to is in Dampier's *"Second Voyage to Campeachy,"* and here there is no word of the formation of a chain or bridge.

Now Sabin quotes Stevens that the sixth edition (the standard one) of Dampier's *Voyages Around the World* is a page for page reprint of the earlier editions, but to make sure I consulted the 1698 or "3d edition corrected" and the 1697, the first, edition of the *Voyages* and found the account therein of the *Second Voyage to Campeachy* to agree exactly with Masefield's reprint of the sixth

It seems to me that the possible explanation is to be found in the third point just indicated. Individual monkeys certainly make use of swinging branches and of great palm leaves to enable them to bridge over the space from one tree to another. Using such a swinging fulcrum for a "take-off," they have been known to leap thirty feet, alighting of course at a lower level than the starting point. A procession of monkeys making such leaps from the same point in succession, especially if some were females carrying young, might look like a "living chain."

I have had the pleasure of discussing the matter with Messrs. Leo E. Miller and George K. Cherrie, of the American Museum of Natural History, and few men in the United States have done more exploring work in northern South America. Furthermore, they are not the ordinary type of travelers but are collectors with highly trained powers of observation. They think that there is nothing in the "monkey bridge story" but that it has come about in a perfectly natural way through observation of a procession of monkeys crossing a ravine or stream on a pendent liana.

Professor W. P. Hay, of Washington, has called my attention to an account of Old World monkeys:

"It is amusing, however—for one is interested in observing the habits of animals all over the world—to see the manner in which these creatures [crocodiles] catch the apes, which sometimes take a fancy to play with them. Close to the bank lies the crocodile, his body in the water, and only his capacious mouth above the surface, ready to seize anything that may come within reach. A troop of apes catch sight of him, seem to consult together, approach little by little, and commence their frolics, by turns actors and spectators. One of the most active or most impudent jumps from branch to branch, till within a respectful distance of the crocodile, when, hanging by one paw, and with the dexterity peculiar to these animals he advances and retires, now giving his enemy a blow with his paw, at another time only pretending to do so. The other apes, enjoying the fun, evidently wish to take a part in it; but the other branches being too high they form a sort of chain by laying hold of each other's paws, and thus swing backwards and forwards, while any one of them who comes within reach of the crocodile torments him to the best of his ability. Sometimes the terrible jaws suddenly close, but not upon the audacious ape, who just escapes; then there are cries of exultation from the tormentors, who gambol about joyfully. Occasionally, however, the claw is entrapped, and the victim dragged with the rapidity of lightning beneath the water, when the whole troop disperses, groaning and shrieking. The misadventure does not, however, prevent their recommencing the game a few days afterwards."[1]

When opportunity came to compare Professor Hay's transcript with the original, I found that the account originated with an explorer and naturalist named Mouhot,[2] who died of swamp fever somewhere in the upper part of Indo-China, but whose journals, letters, and scientific memoranda were used by his brother to build up a book. The original picture in this book is of a scene at Paknam-Ven, on the Chantaboun River, Siam, and bears the legend: "Drawn by M. Bocourt from a sketch by M. Mouhot," so it may be considered authentic.

In his text Mouhot speaks of the apes holding on to each other by their paws, but nowhere does he speak of them as using their tails. The figure, however, does show at least three of them using their tails to hold on to the swinging "bush-ropes." This led me to think, until the figure was finally run down, that it was from some book of travel on South America, where the monkeys do have prehensile tails. Mouhot, of course, knew that while the Old World does have long-tailed monkeys, none of them have this organ prehensile, so we must conclude that his artist "improved" on his original sketch.

(*Continued from page 220*)

edition of 1729. So it seems that Goodrich has made Dampier say what he did not say, and if Dampier, why not Mrs. Loudon? As a matter of fact Goodrich has attributed to Dampier an account possibly taken from Wafer, quoted earlier in this article. Dampier was a keen and critical observer of natural history phenomena and anyone who has carefully read his *Voyages* must conclude that had monkey bridges abounded, as Wafer indicates, he would certainly have given us a careful description, as was his wont when anything new or unusual came within his ken. And even had he not seen it, he would in all probability have made mention of it as seen by others, had talk of it been current.

[1] This account and figure are taken from Siam, the Land of the White Elephant, as It Was, and as It Is, compiled by George B. Bacon and published by Charles Scribner's Sons (New York, 1873), as one of the volumes in *Illustrated Library of Travel, Exploration, and Adventure*, edited by Bayard Taylor.

[2] Henri Mouhot was a Frenchman, but the title of his book is *Travels in the Central Parts of Indo-China (Siam), Cambodia, and Laos, during the years* 1858, 1859, 1860, and it was published in two volumes at London in 1864. Mouhot, who lived in England for some years, seems to have had encouragement and possibly some backing from the Zoölogical and Geographical Societies of London in his explorations.

The Remaking of a Museum Collection

REPRESENTATIVES OF THE ORDER OF PRIMATES FROM THE HUGE GORILLA TO THE TINY MARMOSET

By F. A. LUCAS

IT WAS in 1882, that Mr. Robert Colgate, at the suggestion of Professor Henry A. Ward, decided to present to the American Museum, of New York, the most complete collection of apes and monkeys that could be brought together, and as steps were promptly taken to put this plan into execution, the collection rapidly grew to goodly proportions. Thirty-five years ago, however, collecting was much more difficult and collectors were much scarcer than today, so that after a time the supply of monkeys that could readily be obtained was exhausted, and the growth of the collection became slower and slower. Nevertheless, it was an impressive exhibit, occupying the greater part of one of the central halls of the Museum. Later, however, it lost some of this impressiveness, as increase of collections in other halls, without corresponding increase of the building, brought into the exhibit a number of intruders in the shape of the smaller mammals, so that the hall of Primates lost some of its distinctive appearance; also the ever-increasing amount of scientific work by the Museum staff led to the abstraction of many of the skeletons for study and comparison.

A *Colobus* or horse-tail monkey with its newly born young whose white head may be seen in front of the mother's shoulder. Most monkeys carry their young in this manner, the infant clinging to the parent's fur of its own accord and with its own strength. A side view of this same monkey is seen in the illustration of the group on the opposite page

Quite recently the publication of Elliot's great work, *A Review of the Primates*, caused renewed interest in this particular collection, while collections made by various Museum expeditions in Africa and South America, coupled with improved methods in mounting and displaying specimens, made it both possible and desirable to make such improvements as would bring this hall up to the high standard set by other exhibits. It has been said that some of the greatest reforms have been brought about not by making new laws but by repealing or amending old ones; in the Primates' hall reform has largely been brought about not by discarding the old specimens but by utilizing them to better advantage, and while there have been a few discards, these have been in the way of bright cherry pedestals and of shelves, so that now the visitor is attracted by the animals and not by the supports.

Important additions have been made in the way of groups, four of which have been completed while material for others is in hand; and Man has been represented by figures of the black, yellow, and white races. (See page 235.)

The skeletons formerly scattered through the cases have been brought together, so that the visitor so minded can readily compare the structural resemblances between himself and his more or less distant relatives, or see the general characteristics of the various groups into which the Order of Primates is divided.

The object of the exhibit is to give some idea of the principal species in the Order and their great variety in size and form, which ranges from the huge gorilla to the tiny marmoset, while the habitat groups show characteristic or interesting species in their own haunts.

THE AMERICAN MUSEUM'S GROUP OF *COLOBUS* MONKEYS

These thumbless monkeys (*Colobus abyssinicus roosevelti*) are perhaps the most beautiful of their race, and for this they have paid the inevitable penalty of being hunted by African natives and by Europeans for the sake of their fur. The Abyssinians employ the skins as ornaments for their large rawhide shields and have traded at times extensively in the pelts. *Colobus* monkeys dwell in the tallest trees among the remote forests of East Africa where they find their main sustenance in leaves which they eat in large quantities. For digesting this unusual diet they are provided with large sacculated stomachs. They are relatively slow travelers for arboreal monkeys, even when swinging from branch to branch in their forest homes; but they can make long flying leaps (thirty feet or more) and the white "manes" and tails float out on the air as the creatures proceed from tree to tree or plunge headlong to the ground. When born these monkeys are pure white (see young in arms of monkey at the right and front view of same on opposite page), but they rapidly take on the black and white coloration of the adult.

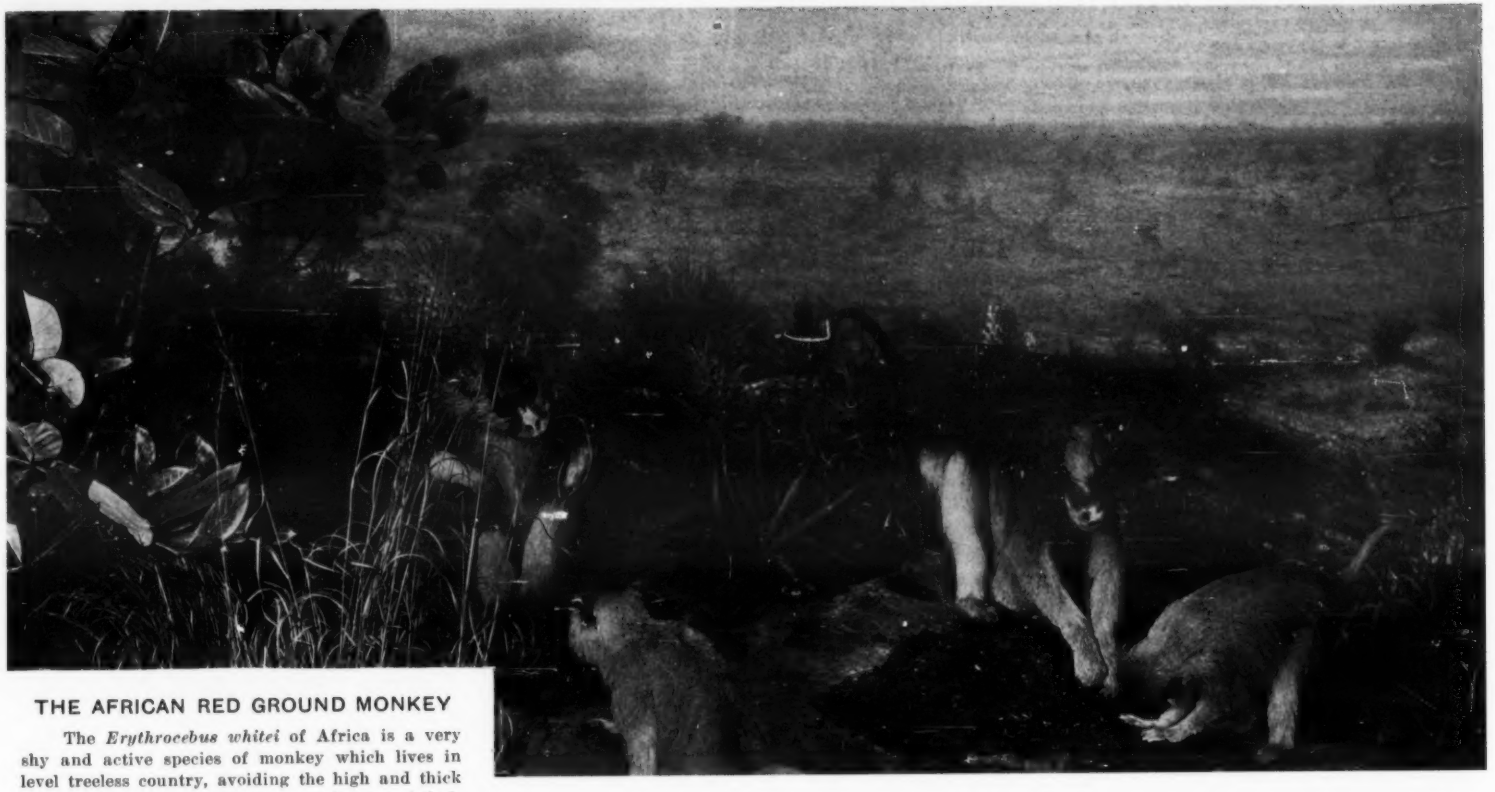
In setting up this group at the American Museum, reproductions were made of leaves and air plants brought from their African habitat by the Congo Expedition

CROWNED LEMURS FROM MADAGASCAR

Among the unique fauna of the island of Madagascar are found the only extant species of true lemurs. The lemurs, which are the lowest of the ape tribe, resemble monkeys chiefly in their hands and feet, having an opposing thumb like most man-like apes. "Lemur" is Latin for ghost and these animals were so called because of their nocturnal and semi-nocturnal habits. They sleep during the heat of the day and come out in the evening and early morning to feed on fruits and romp in the trees in small bands of six or eight. This American Museum group, of which but a corner is shown, contains two species (*Propithecus verreauxi* and *P. diadema*) set in a reproduction of Madagascar foliage with a background painted from a scene out of Milne Edwards' great work on that island

A SPIDER MONKEY FROM MEXICO

The spider monkeys (*Ateles*), so called from their unusually long arms and legs, are a thumbless genus from the New World. They are very timid and rather stupid animals and live on such fruits as are found in the tropical forests of the two Americas. Their most notable character is the prehensile tail which serves them so remarkably well that the Indians of Brazil claim they catch fish with it. This tail, the under side of which is smooth-skinned at the tip, is always moving here and there grasping branches or objects otherwise out of reach, and is sufficiently strong to suspend the weight of the monkey's body. The number of things a monkey of this type can do at one time is quite astounding.



THE AFRICAN RED GROUND MONKEY

The *Erythrocebus whitei* of Africa is a very shy and active species of monkey which lives in level treeless country, avoiding the high and thick woods where other monkeys usually are found. Its food consists chiefly of grubs and insects, which it obtains by rolling back the sheets of moss covering the rocks—much as one might roll up a rug. Owing to its great activity, as well as to the fact that the level country which it frequents is infested with lions and leopards, native hunters seldom get a chance to kill this species. They attribute to it the power of rendering itself invisible and believe that this power is imparted to the fortunate possessor of its skull, who is thereby enabled to approach and slay an enemy without being seen.

The large baboon (*Papio doguera*) at the right in the group is a representative of one of the most brutal of the genera of manlike apes. The baboons roam in large and well-disciplined bands under the leadership of an old male and are, collectively, formidable antagonists. Only rarely has a baboon been semidomesticated; its disposition is bad and its temper very unreliable

Notes

THE geographical and historical basis for a permanent world peace has been the subject of research since the latter part of 1917 by an American organization known as the "Inquiry." This organization has been under the direction of Col. E. M. House, and has maintained its headquarters at the building of the American Geographical Society in New York City, receiving cordial coöperation from every scientific bureau of the United States Government, and being visited in person by President Wilson and Secretary Lansing. Its complete personnel of about 150 persons, carrying with them all prepared effects, sailed for France on the "George Washington" December 4, 1918. The work has been of so confidential a nature that the story in detail is told for the first time in the *Geographical Review* for January, 1919. The Inquiry has, broadly speaking, investigated the political and diplomatic history, the political and economic geography, of all the nationalities in any way affected by the coming treaty of peace, together with the bearings of international law upon these questions. This work has been accomplished through close coöperation of specialists and in consultation with similar commissions in Europe and with representatives of every important nationality of Europe and Western Asia. Among the members of the Inquiry are:

S. E. Mezes, President of the College of the City of New York, *Director*

Isaiah Bowman, Director of the American Geographical Society, *Chief Territorial Specialist*

Allyn A. Young, Head of the Department of Economics at Cornell University, *Specialist on Economic Resources*

Charles H. Haskins, Dean of the Graduate School of Harvard University, *Specialist on Alsace-Lorraine and Belgium*

Clive Day, Head of the Department of Economics at Yale University, *Specialist on the Balkans*

W. E. Lunt, Professor of History, Haverford College, *Specialist on Northern Italy*

R. H. Lord, Professor of History at Harvard University, *Specialist on Russia and Poland*

Charles Seymour, Professor of History at Yale University, *Specialist on Austria-Hungary*

W. L. Westermann, Professor of History at the University of Wisconsin, *Specialist on Turkey*

G. L. Beer, formerly of Columbia University, *Specialist on Colonial History*

Mark Jefferson, Professor of Geography at Michigan State Normal College, *Cartographer*

Roland B. Dixon, Professor of Anthropology at Harvard University

Four officers from the Military Intelligence Division were also attached for special study of problems on strategy, economics, and ethnography: Major D. W. Johnson, Columbia University, Major Lawrence Martin, University of Wisconsin, Captain W. C. Farabee, The University Museum, Philadelphia, and Captain Stanley K. Hornbeck, University of Wisconsin.

In connection with the research carried on by the Inquiry, the cartographers of the American Geographical Society, together with a Government staff, began a great map making program, showing the distribution of peoples and of natural resources, and location of strategic points. The Society prepared a series of base and block maps showing drainage, railways, and relief, of Europe, Asia, and Africa. These maps were later furnished to each unit of the Students Army Training Corps. A small scale edition also has been printed, available for desk use by the students in conjunction with the wall map in the hands of the instructor.

JOHN BURROUGHS visited the American Museum on January 24 and was entertained by moving pictures in which he had acted the leading rôle. Mr. Burroughs was pictured with several of his family, and with friends, including Mr. Henry Ford and Mr. Thomas A. Edison. The groups had been "filmed" in West Park at "Riverby," "Slabsides," and "Woodchuck Lodge." In connection with this reel, about one hundred colored slides were also displayed. Among them were several of his birthplace in the western Catskills, many were from photographs, by Dr. G. Clyde Fisher of the American Mu-

seum, of Mr. Burroughs in his West Park home, and a considerable series showed him with John Muir in California and with Theodore Roosevelt in Yellowstone Park. After the slides had been shown, the local bird hall was visited and the white marble bust of Burroughs, executed by the late C. S. Pietro, was viewed. Mr. Burroughs also examined a number of exhibits in the Museum, including the Florida Group—a group showing Florida reptiles and birds set in a reproduction of a cypress swamp—and visited Mr. Carl E. Akeley's studio where African elephants and rhinoceroses were in process of being mounted. He manifested especial interest in the clay model of an African lion which Mr. Akeley is making as a memorial to Roosevelt. It was a great pleasure to Mr. Burroughs' friends to welcome him to the Museum and to find him in such vigorous health at fourscore years and two.

THE gold medal of the Royal Society for the Protection of Birds (Canada) has been awarded to Professor Gordon Hewitt, Dominion entomologist, and to Dr. W. T. Hornaday, director of the New York Zoölogical Park, "in recognition of their indefatigable services in securing the treaty between Canada and the United States for the protection of migratory birds."

AT the annual meeting of the trustees of the American Museum on February 3, Mr. Herbert L. Bridgman, journalist, explorer, and geographer, manager and editor of the Brooklyn *Standard Union*, and secretary of the Peary Arctic Club, was elected an Honorary Fellow of the institution, pursuant to a resolution expressing "appreciation of the valuable assistance rendered to the Museum by Mr. Herbert L. Bridgman through his service on its committees on exploration, especially in connection with the expeditions of Admiral Peary, the Stefánsson-Anderson Expedition, the Congo Expedition and, more recently, the Crocker Land Expedition—in all of which his wide experience and organizing ability have been placed freely at the disposal of the Museum"—and also acknowledging his "contribution to the advancement of science and education through his editorials and other writings in the public press."

AMONG the names of the officers and founders of the American Ornithologists' Union is that of Robert Ridgway, one of the first vice presidents. Mr. Ridgway lately has completed his fiftieth year on the staff of the Smithsonian Institution, where he occupies the position of curator of birds. He is accounted one of the leading systematic ornithologists of America. His interest in birds began at an early age. When but fourteen he sent a life-size drawing of a pair of purple finches to the Smithsonian Institution and received from Professor Baird, then secretary of the Institution, a letter commending his skill in drawing and offering him assistance in identifying any of his specimens—a service similar to that which Audubon had performed for Professor Baird twenty-five years previously. Systematic ornithology was in its infancy when in 1867 Mr. Ridgway was called to Washington to assist Professor Baird, and its rapid growth may be attributed in large measure to his efforts.

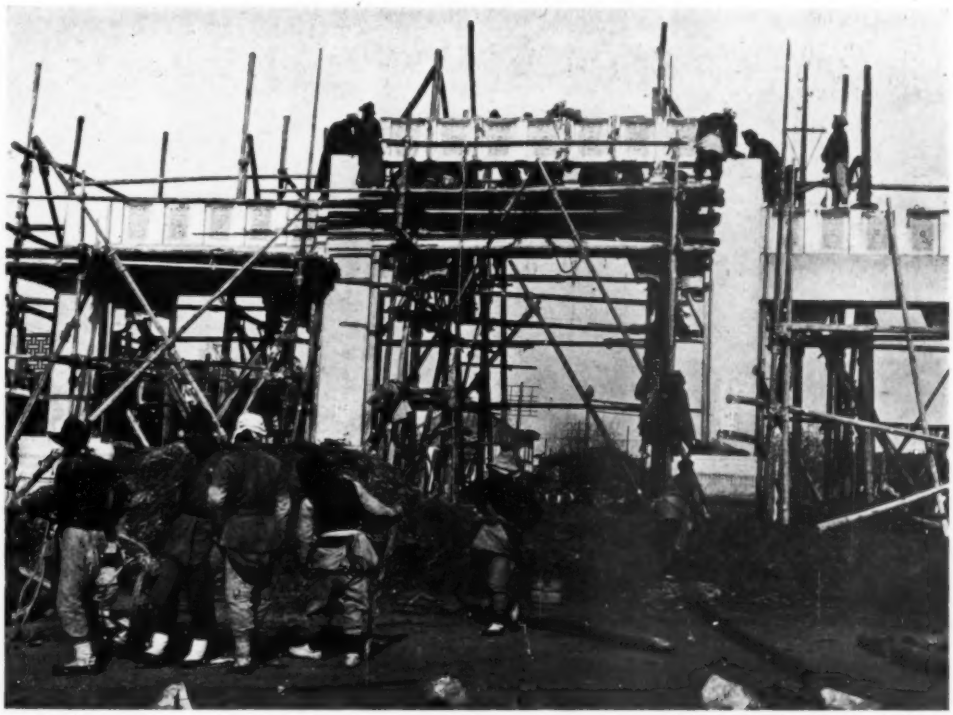
PROFESSOR JOJI SAKURAI, director of the Institute of Physical and Chemical Research in Tokyo, Japan, has been visiting scientific institutions in the United States. The Institute was founded in 1917 by private subscription and government subvention, largely as a result of the effect of the great war in giving government officials, business men, and in fact the whole Japanese nation a new interest in science, relative to such daily needs as dyestuffs and drugs formerly imported from Germany. In order to supply the lack of capable researchers the Institute established a number of scholarships open to university graduates and tenable for two years, and a few of its associate fellows will be annually sent to study abroad. At present the Institute's work is being carried on in the buildings of the universities of Tokyo, Kyoto, and Sendai, but the projected laboratories will be built in northern Tokyo where a site has already been purchased.

IN 1908 foreigners in Peking founded the China Monuments Society for securing "complete suppression of vandalism in China by foreigners, or due to foreign influence or agencies, and the protection of China's antiquities, monuments and all cultural objects, for the benefit of mankind. . . . " Since that date the attention of the Chinese government has been called to the matter at one time and another and considerable interest

has been manifested in America toward cooperation in the work of preservation. Priceless objects of art and historic monuments are still, however, in need of protection from both foreign and domestic vandalism, but, owing to the present state of political turmoil throughout China, it is difficult to obtain any organized effort.

Mr. Roy C. Andrews, leader of the American Museum's Second Asiatic Expedition, recently discussed with Mr. Kungpah T. King ways and means of coöperation. Mr. King, a member of the Chinese Parliament and formerly Minister of the Interior, was most active in the establishment of the National Museum of Art at Peking, and is again taking up the question of protection officially in spite of the difficulties in the way of effective action. The Peking Museum was founded with the wonderful collections left in the deserted summer residences of the Manchu emperors at Mukden and Jehol. Four million dollars (silver) were appropriated for purchasing this material from the Manchu dynasty and half of this sum has already been paid.

The following photographs depict scenes in Peking on the signing of the armistice at the close of active fighting in the World War. They were taken by Mr. Roy Chapman Andrews, representative of the American Museum of Natural History



Photograph by Roy C. Andrews

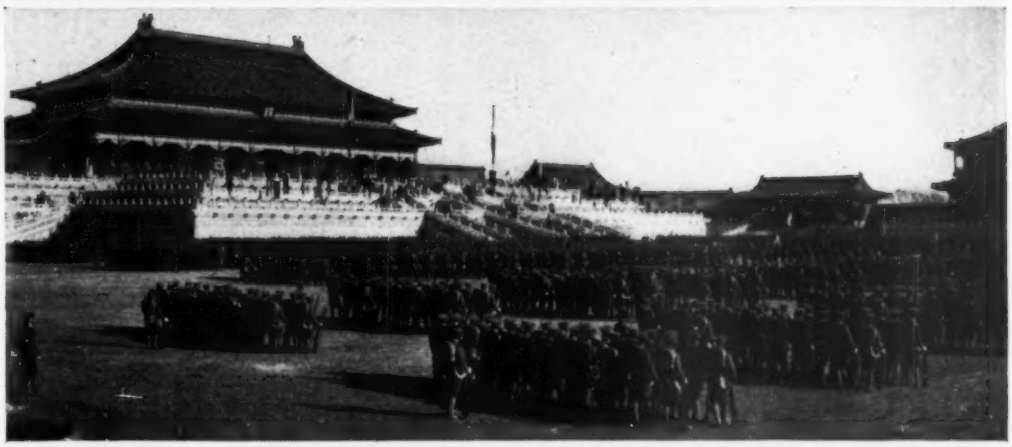
REMOVAL OF THE VON KETTELER MONUMENT IN PEKING

This memorial arch on Ha-ta-mên Street was erected by the late Emperor over the spot where Baron von Ketteler, German Minister to China, was shot by a Chinese soldier. The news of the signing of the armistice in the World War was received in Peking on the morning of November 12. During that afternoon the government gave permission to have the monument removed, and several hundred foreigners attempted to pull the arch down with cables. This attempt was unsuccessful but that night the German inscription was badly defaced and the pillars were chipped and cracked. Later the Chinese government decided to take down the arch, as shown in the photograph, and to use the materials in the erection of a "Victory Arch" in Central Park, Peking

Photographs by Roy C. Andrews

GATEWAY TO THE PURPLE CITY

The upper picture shows the massive gateway to the Tung Hua Men courtyard of the Imperial Palace in Peking. The two lower pictures are taken within the court and show the lancers, part of the President's bodyguard, and the President's band. The gateway is one of the most impressive of the series of entrances through which one must pass in entering the Forbidden City. Its base is red and the roof is tiled with the imperial yellow, as are all the imperial dwellings of the city, while before the gate runs a winding canal spanned by beautiful marble bridges. The photographs of the lancers and band were taken just after the President, Hsu Shih-Chang, had passed through to attend the Allied and Chinese review, held to celebrate the signing of the armistice



Photographs by Roy C. Andrews

REVIEW OF CHINESE AND ALLIED TROOPS

The President of China with the Allied Ministers reviewed a parade of Allied and Chinese troops in the great court before the old Throne Room or Hall of Supreme Concord (Tai Ho Tien). This court is large enough to hold 45,000 people. The brilliance of the scene was indescribable; in the background the yellow tiles of the Tai Ho Tien (one of the most superb examples of Chinese architecture) gleamed in the sunlight like molten gold and in the court and on the terraces were thousands of flags and uniforms of every color. In the picture at the bottom of the page the President is shown reading his address from the terrace of the Throne Room (politically and almost geographically the center of Peking). On the left are the foreign ministers; on the right, the foreign military attachés and General Tuan Chi-jui, ex-Premier, with members of his staff

Photographs by Roy C. Andrews

AFTER THE REVIEW

The upper photograph shows General Tuan Chi-jui, ex-Premier of China, with the Allied military attachés: reading from left to right are two members of General Tuan Chi-jui's staff, the Russian and the French attachés, General Tuan Chi-jui, the British, the American, and the Japanese attachés.

General Tuan Chi-jui is one of the most influential generals in China. It was he who dispersed General Chang Hsu's troops in 1917 when the latter attempted to restore the Manchu Emperor. General Tuan Chi-jui is a stanch militarist and will oppose any attempt to limit the powers of the military governors who practically govern China today.

In the lower picture Chinese troops, preceded by their colors, are seen leaving the court of the Tung Hua Men and about to cross one of the beautiful marble bridges

THEODOOR DE BOOY, archæologist and explorer, died February 19, at his home in Yonkers. Mr. De Booy had been in charge of the West Indian archæological work of the Museum of the American Indian, Heye Foundation, New York City, since 1911. Last year he was in charge of an expedition sent out by the University of Pennsylvania Museum, which penetrated unknown regions in Venezuela and Colombia. Few men knew the West India Islands and their archæology as Mr. De Booy knew them. A skillful and tireless worker, with the faculty of making friends wherever he went, he proved a most successful collector. He was the author of several papers on the archæology of the West Indian Islands, and a short time before his death he brought out, jointly with John T. Faris, the book *The Virgin Islands, Our New Possessions, and the British Islands.*

THE death is announced of two of the country's distinguished botanists, George F. Atkinson, professor and head of the botany department at Cornell University, and Volney M. Spalding, formerly professor of botany at the University of Michigan.

S. A. S. ALBERT, Prince of Monaco, has contributed to the Académie des Sciences,[1] of Paris, a paper on the "Route of floating mines in the North Atlantic and Arctic Oceans during and after the war." Prince Albert has for many years made extensive researches into oceanography and mapped the course of the Atlantic currents by dropping objects so constructed that they floated just below the surface and escaped action by the wind. Mines sown in the North Sea, he says, will wander along the northern European coasts until they are finally swept into the fjords of Norway. Those which break loose on the Atlantic coast of Europe, however, will fall into the general Atlantic currents dominated by the Gulf Stream. Barring accident on the Canary Islands or the Antilles, or protracted circulation in the great Atlantic whirl, the Sargasso Sea, these mines will travel down the coast of Europe and of northern Africa, across the ocean to the West Indies and back by way of the Gulf Stream current. After their return to European waters, the mines will either go by the west coast of Ireland to break in the Arctic ice or in the Norwegian fjords, or return a second time over the previous transatlantic circle. Prince Albert calculates the average speed as somewhere around five miles in twenty-four hours. A complete voyage from the vicinity of the Channel and return would accordingly require about four years.

[1] *Comptes rendus hebdomadaires*, Tome 167, No. 27 (30 Décembre 1918).

"THE time has arrived when there should be a great awakening in the teaching of geography in America," writes Professor W. W. Atwood, in the *Geographical Review* for January, 1919, "and when teaching must go far beyond what most grown people remember as geography." The importance of both physical and economic geography has been strongly brought to our attention by the war and even to a greater extent by the parceling up of the world, contingent upon the signing of peace. Never again will the United States stand in isolation, either political or commercial, and, as our market is to be the world, so we must study the world's geography.

Geography has never been taught to any extent in America beyond the primary schools. Even the teachers of geography are not trained in any phases of the subject beyond the elements, for virtually no courses in geography are given in the colleges. All the higher institutions of learning should open departments of geography as fast as adequately trained instructors can be furnished. There are many students who would take up this field of work as a profession if America recognized it. Each of the large universities in France has a department of geography; there is a staff of eight specialists in geography at the University of Paris. Great English and German universities also are equipped; and similar progress has been made in other countries, as Austria, Switzerland, Italy, Denmark, and the Netherlands. The time has come when full consideration should be given to the relations between geography and the expansion of civilizations.

SIR ARTHUR PEARSON, the blind founder and director of St. Dunstan's Hostel for blinded soldiers, London, addressed a large audience of blind and their friends at the American Museum on February 5. Sir Arthur spoke of the marvelous work accomplished at the hostel and of the new depar-

tures inaugurated there. "Victory over blindness," is St. Dunstan's motto. The hostel impresses upon its new arrivals that it is not an institution for the helpless, but a school where "normal people who cannot see" are reëducated. It is for the blind themselves, said Sir Arthur, to disabuse the public of the belief that blindness is associated with helplessness, and accordingly he believes that the coming of the blinded soldiers in the prime of life from stirring scenes has been the blind's best asset. Play is taken very seriously at the hostel and is considered of equal importance with work; all forms of amusement are encouraged, from boxing to checkers. Dancing is popular with the men. St. Dunstan's Dramatic Club has developed into a regular London institution. Sir Arthur considers outdoor athletics as of particular importance in giving the blind renewed control over their muscles. As they have access to the large lake in Regents Park, rowing is one of the favorite sports, and expert crews are sent to race on the Thames at Putney, while those who have had previous experience in boxing take up this exercise with successful results. Any activity which fosters the competitive spirit promotes rapid development and raises the morale of the men.

The average stay at St. Dunstan's is nine months, during which the men must acquire an occupation, or relearn an old one. They must also learn to read. This last is of the utmost importance, for the mere ability to read continually widens the blinded person's mental horizon and gives him added confidence. In learning an occupation, St. Dunstan's insists that its blind be as capable and stand as thorough examinations as more fortunate competitors in the same field who can see. Among occupations not hitherto thought of in connection with the blind, Sir Arthur Pearson has introduced massage with much success. This is a well-paying profession and is readily learned by those of the blind who are inclined toward the work. Many more trades and professions are suitable for the blind than is generally assumed. The government of the United Kingdom now appropriates an annual sum of two million dollars to be expended in work with the blind.

THE Roosevelt Permanent National Committee, appointed for the purpose of choice and erection of a national memorial to the late Theodore Roosevelt, consists of the following persons, representative of industrial, political, scientific, literary, and social life, and including all of Roosevelt's former cabinet members:

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LUKE E. WRIGHT
WILLIAM WRIGLEY
ROBERT J. WYNNE

THAT man should not be omitted in the consideration of the Primates is the underlying motive in the installation in the hall of Primates of the American Museum (see page 222 of this issue of NATURAL HISTORY) of models of the Norwegian, Chinese, and African races. While there is some diversity of opinion as to whether there is more than one species of man, there are undeniable well-marked races corresponding to the subspecies in zoölogy. Of these the white, yellow, and black races shown in the present exhibit are the principal types. The figures were made by the Washington sculptor, Mr. U. S. J. Dunbar, who has been very successful in reproducing the races of man; the coloring is the work of Mr. Frederick H. Stoll, of the preparation department of the American Museum; the garments worn are actual articles of apparel collected in the field. The white race is represented by a Hardanger peasant of Norway in the costume of a young married woman. This type is found in its purest form in Scandinavia, where fifty per cent of the population are tall, blue-eyed, fair-haired, and long-headed. The yellow type, depicted by the Cantonese farm laborer, has straight black hair, yellowish or copper-brown skin, oblique eyes, high cheek bones, and projecting ears. In securing a model for the coloring and hair of this figure Mr. Stoll had much difficulty in finding a Chinaman with a queue, this form of headdress being no longer popular with the Chinese. He finally discovered an old Chinese chemist who generously served as a study for this figure. The farm laborer of the exhibit, however, has a skin much darker than the Chinaman seen in the streets of New York.

Perhaps the most interesting figure of the group is the African, inasmuch as it is an actual portrait of Manziga, chief of the Azande. The Azande are famous warriors of Central Africa, having pushed their way by force of arms from the Sudan down into the Congo where they are firmly established. They are also known as *Niam-Niam* (meat-meat) because of former cannibalistic tendencies. Now, however, they are an agricultural people, living chiefly on millet, durra grain, manioc, sweet potatoes, and plantain. From the grains they also make intoxicating drinks. The women of the tribe are kept virtually in slavery. The shield carried by Manziga is covered with rattan fiber and is both beautifully designed and carefully made. In war this chief often carries five or six spears, and when these are exhausted his supply is replenished with others carried by men running behind him. The Azande make also peculiar iron throwing knives which have many points and act somewhat as a boomerang when thrown. The dress worn by this figure is made from strips of fig bark beaten with hammers, soaked in water until very flexible, and then woven into cloth. The designs are stamped on with a die—such a die often consisting of the dried section of some fruit.

THE complete dress costume of an Indian chief, comprising a large feather war bonnet, fringed shirt and leggings, with moccasins, pipe bag, and feather-trimmed standard, has been presented to the American Museum by Mrs. Anna Sargeant of Jersey City. The costume was the property of Chief White-eagle, a Cheyenne Indian of mixed blood, who had left a request with Mrs. Sargeant that this costume be presented to the Museum in case of his death. Chief White-eagle passed under the name of Don White-eagle. Before entering the Army he had been for several years connected with Barnum and Bailey's Circus. When America entered the war he was moved with intense patriotism and offered his services in the Liberty Loan Drives, having at one time a tipi in front of the New York Public Library where he appeared in the costume just presented to the Museum, and addressed passers-by on their duty with respect to the loan. These appeals were so successful that he visited other parts of the country on a similar mission. Later, he took part with equal success in Red Cross and War Savings Stamp campaigns. He entered the United States Army in July, 1918, and died in France of pneumonia, October 21, 1918, but not until after he had received special commendation by the general of his division for bravery of action at the front.

As a small help in the work of reforesting woodland areas in France, Mr. Percival S. Ridsdale, secretary of the American Forestry Association and editor of *American Forestry*, in visiting that country recently, carried with him a large number of Douglas fir seeds—"a small package with a big value," cabling after his arrival that the French government accepted the offer of aid tendered by the Association.

WE NOTE with satisfaction the great step forward taken by Governor Sleeper of Michigan, in urging the foundation of a system of connected public parks through the state. In Indian days the northern part of Michigan was closely covered with the heavy coniferous forest which extended across the Lake Region as far as Minnesota, and the southern section by the edge of the hardwood growth of the Ohio River Valley. Even today a large part of the state is wooded with a rich and varied forest, representing about a hundred native species. Sectors of woodland along many of the quiet streams and hidden lakes are ideal locations for forest parks. Heretofore, Michigan has given no attention to this form of conservation, so that her fields and woodlands have been rapidly restricted by private ownership. Governor Sleeper's project will involve not only the setting aside of ground, but also extensive work in forest preservation and reforestation.

IN connection with the discussion of scenic conservation by Dr. R. M. Harper in this number, we note the progress made in the state of New York as reported by the American Scenic and Historic Preservation Society. Since 1849 New York has bought, at one time and another, about thirty-five public parks and monuments. These are for the most part historical sites, associated with events and persons of importance in American history. Twenty-two of these monuments have been purchased since 1900. Among them is Stark's Knob near Schuylerville where, during the Revolution, Captain Stark built a redoubt to oppose General Burgoyne at the Battle of Saratoga. Temple Hill Monument at New Windsor was presented to the state in 1917. It is on the site of the famous "Temple of Virtue" erected in 1783 in honor of the anniversary of the French Alliance. Here Washington publicly spurned the suggestion that he become king of the Thirteen Colonies. New Windsor is also interesting to us today as the former site of a large military cantonment—the last of the Revolutionary War.

A *Handbook of Travel* has been prepared by members of the Harvard Travellers Club, under the editorship of Mr. Glover M. Allen, secretary of the Boston Society of Natural History. The first part of the book contains practical suggestions on methods of travel in various climates, of observations on camp cooking, firearms, equipment, and of notes on different beasts of burden from Eskimo dogs to camels. Each heading is contributed by an expert in the given field; for instance, the late Oric Bates, famous archæologist and explorer of the Near East, tells how to ride and how not to ride a dromedary; and Langdon Warner, director of the proposed American School of Archæology in Peking, describes the food and disposition of a two-humped camel, and of its Mongol owner. A very fascinating chapter on "Hunting Dangerous Game" is contributed by Dr. William Lord Smith. Dr. Smith's danger order is "elephant, tiger, lion, leopard, grizzly bear, rhinoceros, buffalo, gaur, banteng, other bear." Not the least valuable sections of the handbook are nine chapters, for the most part by members of the Harvard Faculty, on hygiene, astronomical observations, route surveying, photography, geology, meteorology, natural history collecting, anthropology, and "Notes on Traverse Surveys in Tropical South America." The expert here describes for the nonexpert the kinds of observations that may be made by the latter and gives directions how to take and record the facts. The chapter on "Hygiene, Medicine, and Surgery" is particularly complete, embodying not only a treatment of ordinary hygiene but also the diagnosis of common diseases, diseases peculiar to the Arctic and the tropics, surgical practice, and medical methods and equipment. In discussing geology and geography Professor William M. Davis gives considerable advice as to how to record interesting and valuable facts, writing on the assumption that "the traveller proposes eventually to publish an article or a book concerning his travels."

EDWARD CHARLES PICKERING, Paine professor of practical astronomy and director of the observatory at Harvard, died on the third of February at the age of seventy-three. Before his selection by President Eliot for the Harvard Observatory, Professor Pickering was instructor in mathematics and subsequently professor of physics in the Massachusetts Institute of Technology where he inaugurated the first physical laboratory in the United States for purposes of instruction.

At the Harvard Observatory Professor

TIMBER WOLVES OF THE ROCKIES

Timber wolves on a deer trail at the foot of the Arapahoe Peaks, Colorado, as displayed in a panoramic habitat group recently mounted in the American Museum. The timber or gray wolf (*Canis nubilis*) is widely known for its predacious habits. Even today it is a scourge to game and stock, and in sparsely populated districts has easily held its own against dogs, traps, and rifles. All the wolf-infested states offer generous bounties and the United States Forest Service undertakes to destroy wolves on the forest ranges. The group in the American Museum attempts to reproduce through effects of lighting the coldness and brilliancy of a winter night in the mountains. It was planned by Mr. Hobart Nichols, of New York City, who also painted the view of the Arapahoe Peaks of the Silver Lake Region which forms the background. The wolves were mounted by Mr. Coloman Jonas, of Denver; the foreground of snowdrifts and trees was executed by Messrs. A. E. Butler and W. B. Peters

Pickering was noted for his pioneer work in the field of astrophysics (the "new astronomy"). Great advances in photographic technique were made during the early years of his incumbency and he quickly appropriated photographic methods for his astronomical studies, founding the great Harvard photographic library. He also devised new methods of measuring the brilliancy of stars and of classifying stellar spectra. Professor Pickering was especially known for the great personal interest and assistance he was so anxious to extend to any astronomical enterprise, and in the Harvard Observatory many of our contemporary astronomers received the inspiration for their scientific labors.

Two small monographs[1] on mahogany list the various species of woods that are commercially sold as mahogany and even attempt to redefine the name so as to include many other red timbers. True "mahogany" is the wood of two closely related species (*Swietenia mahagoni* Jacq. and *S. macrophylla* King) the distribution of which is limited to tropical America. Mr. Mell, author of the American volume, gives a list of sixty-one other "mahoganies" from all parts of the world, and Professor Dixon, author of the British book, describes the microscopical character of forty-five species with 138 reproductions of microphotographs. Mahogany was the chief wood used in England and Spain for shipbuilding during the eighteenth century, but with the gradual diminution of accessible supplies and the introduction of substitutes it has gradually disappeared from the trade except for use in the framework of small sailing vessels and the outer planking of yachts. The great mahogany-framed ships have been sold for enormous sums to be cut up for the manufacture of furniture. Today mahogany is a very high-priced lumber employed almost exclusively in joinery and cabinetmaking. Mr. Mell gives the selling price of the best grades in New York in 1917 as from $175 to $200 a thousand board feet.

Fustic wood (*Chlorophora tinctoria*), the wood with which our khaki and olive drab uniforms are dyed, has experienced a period of intensive cutting during the last four years. It is said that fustic has been bringing $45 and $50 a ton in New York, whereas it formerly ranged from $20 to $25 a ton. The wood is imported as logs from Mexico, Central and South America, and the West Indies, and after grinding, is used in the form of a water infusion for producing various shades of yellow, brown, olive, and green, for use particularly upon silks and woolens. It can also be compounded with other dyes for drabs, fawns, and olives, and with logwood for black. The fustic tree grows best near the coast and well drained banks of rivers, but, of course, the most accessible localities have already been cut off. One or two trees to the acre of forest is the average growth, a fact which makes getting out the fustic wood anything but profitable, and this is particularly true where it is necessary to employ land transportation through roadless country.

An important series of descriptive works on the flora of the state of Florida has been issued during the last few years by Dr. John Kunkel Small, head curator of the Museums and Herbarium of the New York Botanical Garden. Dr. Small wrote in the Journal of the American Museum for December of one of his several collecting trips to little explored sections of the Everglades and the islands off the Florida coast. The handbooks are based for the most part on material which he has collected on such expeditions and are much more complete than any survey hitherto published. They include *Florida Trees, Flora of the Florida Keys, Shrubs of Florida, Flora of Miami* (all 1913), *Ferns of Royal Palm Hammock* and *Ferns of Tropical Florida* (1918). The last two are extensively illustrated with drawings of the ferns and photographs of their habitats. Southern Florida constitutes a unique province in the United States, being the only point touched by a strictly tropical vegetation, so that these extensive studies by a distinguished botanist form not only an extremely valuable addition to systematic botany but also practical guides to the identification of the trees, flowers, and ferns of Florida by the interested sojourner there.

Guatemala, with every confidence in her natural wealth of field, forest, and pasture, has traveled far on the route to recovery

[1] H. H. Dixon, *Scientific Proceedings of the Royal Dublin Society*, vol. xv., p. 431, and C. D. Mell, U. S. Department of Agriculture, *Bulletin* 474, February, 1917.

after the great earthquake catastrophes of December, 1917, and January, 1918.[1] New and earthquake-proof structures are being raised of reënforced concrete and galvanized iron. Quick reconstruction was planned for the schools, and President Cabrera seized the opportunity to improve the school system and to establish a National University, whose faculty, under a superior council, will govern the curriculum of the primary and secondary schools of Guatemala. Within six months after the destruction of the city more than a million dollars had been contributed by citizens and friends and the preliminary steps toward reconstruction had already been taken.

THE section of books on folklore in the Library of the American Museum of Natural History, which has hitherto been somewhat undeveloped, has acquired by purchase 1034 volumes dealing mainly with European and Asiatic folklore and related subjects. In the selection of these works the Library has been ably assisted by Dr. W. L. Hildburgh, who has made a special study of this branch of literature.

[1] See description of the earthquake by an eye-witness, "The Guatemala Earthquake." By Sylvanus Griswold Morley, AMERICAN MUSEUM JOURNAL, Vol. XVIII, March, 1918.

AT a February meeting of the trustees of the American Museum, Messrs. Horace F. Hutchinson, Richard B. Kelly, and Dr. E. W. Gudger were elected life members of the institution in recognition of services rendered. Mr. Frederick Potter was elected a Fellow, Mr. William Averell Harriman, a Patron, and Mr. George F. Baker, an Associate Benefactor in recognition of their generous contributions and interest in the Museum's work.

MR. G. K. NOBLE has been appointed assistant curator of herpetology in the American Museum and Mr. Karl P. Schmidt assistant in herpetology. Mr. Barrington Moore, formerly associate curator of woods and forestry, who has been in France with the forestry branch of the Engineering Corps, has been appointed research associate in forestry.

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Associate Benefactor, GEORGE F. BAKER.

Patron, WILLIAM AVERELL HARRIMAN.

Fellow, FREDERICK POTTER.

Honorary Fellow, HERBERT L. BRIDGMAN.

Life Members, MAJOR NOEL BLEECKER FOX, DR. E. W. GUDGER, MESSRS. CHARLES B. CURTIS, GANO DUNN, HORACE F. HUTCHINSON, RICHARD B. KELLY, HUSTON WYETH, and GEO. A. ZABRISKIE.

Sustaining Members, MISS S. D. BLISS and MR. GEO. W. MANN.

Annual Members, MESDAMES FREDERICK FRELINGHUYSEN, ALBERT EDWARD HURST, WILLIAM LOEB, JR., WALTER WILLSON METCALF, WHEELER H. PECKHAM, ALICE B. TWEEDY, JOHN COLIN VAUGHAN, MISS M. R. CROSS, LIEUT. JOHN KING RECKFORD, THE RT. REV. MGR. M. J. LAVELLE, DOCTORS ROBERT ABRAHAMS, MILO HELLMAN, ALBERT R. LEDOUX, GEORGE GRANT MACCURDY, EDWARD H. SQUIBB, MESSRS. FREDERIC W. ALLEN, FRANK L. BABBOTT, ADOLPH D. BENHEIM, NATHAN I. BIJUR, CECIL BILLINGTON, CHARLES M. BREDER, JR., FREDERICK G. CLAPP, GEORGE W. DAVISON, JOSEPH P. DAY, WILLIAM J. DOWNER, JOHN W. EVERITT, FRANK S. HACKETT, FRANK MORTON JONES, G. P. KLAAS, SAMUEL HOWELL KNIGHT, JOSEPH G. LIDDLE, DANIEL M. LORD, JUDSON LOUNSBERY, S. MALLET-PREVOST, ROBERT MARSHALL, WM. M. MCBRIDE, TOMPKINS MCILVAINE, WM. MELZER, HARVEY MURDOCK, C. W. NICHOLS, WILLIAM C. PATE, JOSEPH READ PATTERSON, LIONELLO PERERA, ARTHUR C. ROUNDS, HOWARD A. SCHOLLE, H. S. STILES, JOHN TATLOCK, ELI S. WOLBARST, and ALL HALLOWS INSTITUTE.

Associate Members, THE REVEREND WALTER F. TUNKS, THE HON. WALLACE MCCAMANT, DOCTORS J. M. ARMSTRONG, JAMES S. GILFILLAN, OSCAR OWRE, M. ROBERT WEIDNER, PROFESSOR S. C. SCHMUCKER, MESSRS. C. F. ADAMS, J. D. ARMSTRONG, J. W. CLISE, A. A. CRANE, GAYLORD C. CUMMIN, R. I. FARRINGTON, JAMES A. GREEN, H. SHUMWAY LEE, ERNEST P. LENIHAN, WILLIAM COLHOUN MOTTER, WINTHROP G. NOYES, ROGER B. SHEPARD, A. T. SIMPSON, B. W. STEPHENSON, RALPH WHELAN, PHILIP T. WHITE, and WILLIAM O. WINSTON.

The American Museum of Natural History

Its Work, Membership, and Publications

The American Museum of Natural History was founded and incorporated in 1869 for the purpose of establishing a Museum and Library of Natural History; of encouraging and developing the study of Natural Science; of advancing the general knowledge of kindred subjects, and to that end, of furnishing popular instruction.

The Museum building is erected and largely maintained by New York City, funds derived from issues of corporate stock providing for the construction of sections from time to time and also for cases, while an annual appropriation is made for heating, lighting, the repair of the building and its general care and supervision.

The Museum is open free to the public every day in the year; on week days from 9 A.M. to 5 P.M., on Sundays from 1 to 5 P.M.

The Museum not only maintains exhibits in anthropology and natural history, including the famous habitat groups, designed especially to interest and instruct the public, but also its library of 70,000 volumes on natural history, ethnology and travel is used by the public as a reference library.

The educational work of the Museum is carried on also by numerous lectures to children, special series of lectures to the blind, provided for by the Thorne Memorial Fund, and the issue to public schools of collections and lantern slides illustrating various branches of nature study. There are in addition special series of evening lectures for Members in the fall and spring of each year, and on Saturday mornings lectures for the children of Members. Among those who have appeared in these lecture courses are Admiral Peary, Dean Worcester, Sir John Murray, Vilhjálmur Stefánsson, the Prince of Monaco, and Theodore Roosevelt. The following are the statistics for the year 1918:

Attendance in Exhibition Halls	627,302
Attendance at Lectures	64,036
Lantern Slides Sent out for Use in Schools	72,287
School Children Reached by Nature Study Collections	817,610

Membership

For the purchase or collection of specimens and their preparation, for research, publication, and additions to the library, the Museum is dependent on its endowment fund and its friends. The latter contribute either by direct subscriptions or through the fund derived from the dues of Members, and this Membership Fund is of particular importance from the fact that it may be devoted to such purposes as the Trustees may deem most important, including the publication of NATURAL HISTORY. There are now more than four thousand Members of the Museum who are contributing to this work. If you believe that the Museum is doing a useful service to science and to education, the Trustees invite you to lend your support by becoming a Member.

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